Retrofitting Homes for a Recessionary Era;
Energy Efficiency Retrofitting Services (EERS) sector characteristics and routes to increased activity.

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Abstract

Within the UK, energy efficiency improvements within the existing housing stock is a key area in which governments have attempted to increase rates of activity to boost carbon reduction and end user cost savings. The most recent UK policy, the Green Deal, was a pay as you save scheme, linking the capital cost of improvements to ongoing energy bill payments.

The success of this policy was limited, with minimal uptake in comparison to expectations. This research investigates the viewpoints of retrofit industry practitioners, to assess their experiences of working under the Green Deal, and evaluate what pathways could be available to move forward into the future. UK and German based individuals interviews were used to compare experiences, along with UK group interviews and focus groups to develop findings via a grounded theory approach, to illuminate possible future strategies for UK retrofit.

Key findings suggest EERS expansion is most successful if policies are designed more holistically; UK policies show strategies which focus on simply the property and not the occupants have their disadvantages. Therefore, a move away from marginal financial incentives, such as the Green Deal's loan structure, to a wider consideration of how policy tools interact with supply chains and end users, would enable increased impact. Precise strategies identified to achieve this include; EERS sector members providing an attractive investment prospect to customers external to any government subsidy, linking of energy efficiency improvements with more standard property upgrades, and an increase in training levels to increase professionalism.

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List of Published Papers

Gooding, L. and Gul, M. S. (2014). Breaking Down Barriers to Achieve UK Domestic Energy Efficient Retrofit at Scale; Lessons To Be Learnt From The German Policy Landscape. Paper to 2014 ENHR Conference.

Gooding, L. and Gul, M. S. (2015). Understanding the effectiveness of the Green Deal; a study of policy impact on the retrofit supply chain. *ECEEE Summer Study 2015.*

Gooding, L. and Gul, M. S. (2016). Energy efficiency retrofitting services supply chains: A review of evolving demands from housing policy. *Energy Strategy Reviews*, *11*, 29-40.

Gooding, L. and Gul, M. S. (2016). Analysis of the growth characteristics of the UK's Energy Efficiency Retrofitting Services (EERS) sector; lessons to be learnt from Germany. Paper to 2016 WSED Conference in Wels, Austria.

Gooding, L., and Gul, M. S. (2017). Achieving growth within the UK's Domestic Energy Efficiency Retrofitting Services sector, practitioner experiences and strategies moving forward. *Energy Policy*, *105*, 173-182.

Key terms

Retrofit is used in a general manner to cover many different concepts in varying contexts. Within this research retrofit or retrofitting is the installation of energy efficiency measures into an existing property. An energy saving measure is any material, product or technology which increases the energy performance of a property. Retrofit activities can take place in all types of construction within the built environment, however within this case, to place boundaries on the research, focus is provided by only investigating domestic properties.

The ***Energy Efficiency Retrofitting Services (EERS) sector*** is broadly classified as a group of businesses and individuals who are tasked with implementing retrofit schemes of works, and therefore can include upstream organisations such as building product suppliers, and designers, or on site installers and technicians entrusted with the task of bringing a project together.

Retrofit policies within this research are government incentive schemes which are designed to increase the level of retrofit activity taking place. Of particular note here is the ***Green Deal***, the UK government's most recent retrofit policy. The scheme sought to provide conditions where finance, in the form of loans could be accessed by home owners and attached to a property, enabling retrofit works to be carried out, without the need for personal capital, or debt.

Abbreviation List

Key term	Abbreviation
CBRP	CO_2-Building Rehabilitation Programme
CERT	Carbon Emissions Reduction Target
CESP	Community Energy Saving Programme
CWI	Cavity wall insulation
DBIS	Department for Business, Innovation and Skills
DECC	Department of Energy & Climate Change (became part of Department for Business, Energy & Industrial Strategy in July 2016).
ECEEE	European Council for an Energy Efficient Economy
ECO	Energy Company obligation
EERS	Energy Efficiency Retrofitting services sector
ENHR	European Network for Housing Research
EPC	Energy Performance Certificate
EST	Energy Saving Trust
GD	Green Deal
GGGI	Global Green Growth Institute
GHG	Green House Gas
EU	European Union
KfW	Kreditanstalt für Wiederaufbau (German government-owned development bank).
OECD	Organisation for Economic Co-operation and Development
PAYS	Pay as you save
R+D	Research and Development
SAP	Standard assessment procedure
SME	Small and medium-sized enterprises
TC	Transaction Cost
TSB	Technology Strategy Board (now Innovate UK)
UN	United Nations
UNEP	United Nations Environment Programme

Chapter 1. Introduction and research context

Domestic energy efficiency and the ability for tenants and home owners to live comfortably and affordably have been long standing foundation stones in the energy policy discourse. These factors have taken on enhanced importance as calls for heightened sustainability; economic activity and energy security have amplified (Green Growth Group, 2013; While, 2013). From a sustainability perspective, the built environment in 2013 was estimated to use 37% of all energy consumed within the UK (CCC, 2014), plus domestic dwelling energy usage accounts for approximately 25% of UK carbon emissions, with more than 80% of this energy usage caused by space and water heating (Webber et al., 2015; Palmer and Cooper, 2012; DECC, 2013a; DECC, 2012a). As a significant area of energy consumption, the Group of 8 (G8) countries have determined built environment energy efficiency improvements to be cost efficient and substantial in having the potential to save 8.2 $GTCO_2$ per year, by 2030 (IEA, 2009).

This reduction in carbon emissions via energy efficiency increases is deemed necessary by government policy (CCA, 2008), to meet the UK's target of an 80% carbon reduction from 1990 levels by 2050 (CCC, 2014). Many supporters maintain that increasing domestic property energy efficiency via private sector delivery channels will meet sustainability and economic growth targets simultaneously (Dowson et al., 2012). To meet these targets, capacity expansion within the Energy Efficiency Retrofit Services (EERS) sector is required. This expansion involves the assurance that equipment, materials, production processes, investment, and the skills base are in place to generate and absorb demand (Isaksson et al., 2010; Koh et al., 2012; Sinha, 2009). Moreover, this increase also involves the tackling of high levels of building heterogeneity, occupant needs and behaviour variance, financial requirements, and low levels of new build properties replacing existing buildings (Kelly, 2009; Stafford, et al., 2012). This challenge of increasing capacity is therefore shown to be multifaceted; composed of numerous hurdles, which combine to produce a large efficiency gap between the level of retrofit being completed and the level which is possible (Jaffe and Stavins, 1994).

There is a sizeable volume of research which details the carbon impact buildings have upon the UK's national carbon dioxide (CO_2) emissions and also the levels of potential interventions which could be implemented to reduce these emissions (Boardman, 2003; Dowson et al., 2012; Galvin and Sunikka-Blank, 2013; Mallaband et al., 2013; Shorrock et

al., 2006). The process of implementing low carbon retrofitted measures within existing buildings is multifaceted (Dixon and Eames, 2013; Kelly, 2009; Stafford et al., 2012), requiring a high degree of learning to ensure that the process of generating retrofit growth is fully understood.

In a bid to increase understanding of how retrofit capacity growth could occur, this research focuses in on the EERS sector's role in reducing the impact and extent of the energy efficiency gap.

This gap is the differential between potential energy savings and actual achieved savings. Therefore it can be viewed as the failure of consumers or end user to make investments which result in energy savings. This viewpoint was first detailed by Hausman (1979), who stated that purchasers of efficient goods discount future savings which can be made via the increased efficiency. This undervaluing of savings has also been detailed in relation to car purchase (Allcott and Wozny, 2014), and also energy efficient products (Hefland and Wolverton, 2011). The overall result of this is that the diffusion of energy efficiency in terms of a cultural attribute is slowed. Jaffe and Stavins (1994), take the concept of the energy efficiency gap a step further to state that any diffusion rate less than optimal is a rate affected by this gap.

The Green Deal (GD) heavily relied upon the EERS sector, to enable retrofit at scale, and energy efficiency gap reduction (Janda et al., 2014; Killip et al., 2013). The GD attempted to achieve this by providing finance to home owners via a pay as you save scheme. This meant energy efficiency upgrades could be carried out with a loan fund secured against a property, with repayments being derived from energy bill repayments. In a move to limit government financial commitment to the policy, public subsidy was reduced significantly when compared to predecessor schemes. For instance the Green Deal received £0.24bn per year of government funding in relation to the Carbon Emissions Reduction Target scheme (2008-2012) which received £0.79bn (NAO, 2016). This strategy of financial support reduction was carried out to provide the retrofit supply chain with the option to manage the implementation of the policy.

In the case of this research this unprecedented change in policy therefore offered a research opportunity to assess the barriers and drivers to EERS sector growth, and what circumstances could be brought in to best increase retrofit activity. Consequently, within the qualitative

research, viewpoints of commercial actors within the sector are utilised via individual semi structured interviews in the UK and Germany, group interviews and focus groups, to best consider the types of sector/policy interaction taking place. Firstly the role of stakeholders is considered within the retrofit situation, due to the importance of businesses and different individuals coming together to enable successful project completion. Secondly, transaction costs (TCs), or hidden costs are emphasised, due to their negative impact upon retrofit business operations. This negative impact limits the level of profit businesses can derive from retrofit projects, and therefore highlights the need for these costs to be minimised.

1.1 Research Questions

Resultant from existing literature investigations, the key research questions under assessment here are;

- What policy strategy needs to be implemented to optimise private sector businesses to enable large scale increases in domestic retrofit activity?
- How can the retrofit supply chain be best configured to increase capacity and capability?
- What lessons can be learnt from recent policy mechanisms to limit the negative impacts of the gap between potential energy efficiency and achieved efficiency levels?
- What strategies are emergent from on the ground retrofit supply chain practitioners to break down barriers to retrofit?

Taking these key research questions, the following aim and objectives form the areas which this research is attempting to address.

1.2 Research Aim and Objectives

The overall research aim is to **enhance existing knowledge of how to learn from on the ground EERS sector practitioners, to create policy conditions to minimize barriers to growth.** This learning can aid insight into future policies to support the effectiveness and success of the EERS sector and also the overall energy efficiency of the construction sector. The potential for improvements within the technical performance of the UK housing stock has been detailed as being extensive, with strategies to limit energy demand via insulation, air

tightness, energy efficiency technologies all being seem as valid, along with low carbon energy production technologies such as solar, wind and heat pumps. Therefore from this a house can be viewed as a system, with the occupants forming a vital part of that system. Therefore to ensure that this system is properly understood and dealt with to improve energy efficiency, the capabilities and characteristics of those individuals and companies who professionally retrofit buildings needs to understood. This is seen as a vital segment within the equation which could lead to the optimisation of policy interventions to improve national existing dwelling performance.

To achieve this aim, the following objectives are pursued:

1. ***To assess how the EERS sector and related government policies attempt to boost EERS sector activity.***

This objective focuses on assessing sector development; in particular the focus is to evaluate how the EERS sector has changed over a timescale similar to the Green Deal's (GD) operation period.

2. ***To assess the performance of the UK's and Germany's policy landscapes, and the outcomes of policy mechanisms.***

Focusing on barriers to the EERS sector, the assessment here aims to look at market and technological developments within the sector (minimisation of EERS sector TCs, and barriers to emergent innovative products), and also the changing structures of the sector and the related learning and development processes (the changing market and network structures within the EERS sector). In assessing the sector across these factors, a holistic review of the state of the industry is produced. Furthermore, in evaluating the UK and German EERS sector landscapes, a comparison across national borders occurs, to enable insight into possible alternative methods of operation. Germany in particular is selected here as a comparative case due to its relative success of national policies and finance mechanisms in achieving higher levels of retrofit activity than the UK.

3. ***To pinpoint influential factors affecting the performance of policy and the EERS sector.***

With the identification of influential variables a suggestion is made as to how specific areas of policy and aspects of the EERS sector are performing less successfully than others. From this, a suggestion of how areas should or could be changed is made.

The findings of this research intend to assess the evolution of the EERS sector under the changing public spotlight. The intention methodologically is to make a novel contribution into how business sectors and policy relationships are assessed. To gain a holistic assessment of the sector and the impacts of policy, TC analysis and stakeholder assessments will be utilised in conjunction. This offers insight into the industry from two different directions, that of business and market structure, and that of networks and individual actors. Overall this generates a contribution to the knowledge base of how the characteristics of policy impact upon the success of how a policy is implemented and also the policy's overall performance.

1.3 Research Structure

This introductory chapter serves the role of defining the justification for this study and presents the context, and problem outline of the research.

Chapter 2 is the literature review for this study and outlines the existing base of research for retrofit, related policy and the EERS sector. This review varies in disciplines and brings together numerous strands of research related to retrofit supply chains, and the task of increasing retrofit activity. Resultant from the literature review is the justification of the research gap, and subsequent research questions, aim and objectives.

Chapter 3 details the research strategy and philosophy, providing a foundation for the data collection route. Chapter 4 then covers the methods behind the research and how these will be implemented in more detail. Chapter 5 presents the results of the data collection from the different stages of acquisition. This results section provides the initial building blocks of the discussion within chapter 6. This discussion covers the implications of the data, and the significance of the results from the previous chapter, along with outlining pathways policy and the sector could adopt into the future.

Finally chapter 7 offers conclusions and recommendations resultant from the research, along with overall contributions to academia. These statements and suggestions are emergent from

the entirety of the research process and bring together the data along with assessment and reflection to provide well thought through recommendations for higher success within the EERS sector.

1.4 Audience

With this research being UK centric, the emergent results, discussions, policy implications and conclusions are of particular relevance to the following groups:

- *The research community:* this study, due to its academic nature, is of interest to other individuals and organisations carrying out research in the area of low carbon domestic retrofit and the related supply chain.
- *Policy makers:* due to the emphasis upon policy learning here, and the objective of producing policy recommendations, this research is of relevance to those who are coordinating retrofit related policy schemes. The emphasis on ground level experiential data also provides a high degree of relevance of how the EERS sector has been working with policy schemes and the reception different initiatives have had.
- *Non-government related groups*: organisations such as Innovate UK (formerly the Technology Strategy Board) along with groups such as the Energy Saving Trust could also gain insight from the findings. Particularly how retrofit policies are being received, and how their role could be altered to best operate alongside EERS sector individuals to create retrofit at scale.
- *The EERS sector*: in providing a compilation of different insights from both a UK and Germany EERS sector perspective, there is also the possibility of supply chain practitioners gaining knowledge from other participant experiences and suggestions. This is of particular relevance when assessing how business strategies should be formed to best take advantage of policy implementation and increase the level of retrofit activity taking place.

1.5 Research Justification

The UK's residential housing stock must be altered at a large scale to be brought in line with climate change targets. Within the UK, domestic properties consume more energy than any other factor within Britain's society and in turn emit the largest amount of CO_2 (Boardman, 2003; Osmani and O'Reilly, 2009). This low performing building stock has been in the past, subject to retrofitting from schemes promoting insulation or heating system improvements.

This focus on ‘easy wins’ or ‘low hanging fruit’ however has meant improvements have only scratched the surface of the levels or retrofit which could be possible. To accelerate the pace and depth at which the transformation of the housing stock is taking place, the UK government has implemented the GD and reformed Energy Company Obligation policy schemes. These mechanisms enable homeowners, tenants and businesses to generate energy savings via energy efficiency retrofitting improvements, without the need for any upfront finance (Rosenow and Eyre, 2013). The success of the GD which relies on private industry for implementation and not public funds is of high importance, due to half a million property low carbon retrofits needing to be delivered each year to meet the 2050 carbon reduction targets (Killip, 2012). It is evident therefore that to enable this rate of change, large scale modifications are required in retrofit supply chain operations strategies and products and services offered (EST, 2010; Lowery, 2012). In the UK however, the EERS sector has in the past been considered as a subsector of the more general construction industry (Genovese et al., 2013). The implication of this subsector status is that the retrofit supply chain can be considered as fragmented and embryonic (Goldman et al, 2010). Furthermore, within the UK, businesses trading specifically to tackle energy efficient retrofit tasks are in the main, small in size and limited in their geographic coverage. Therefore, for a policy such as the GD to operate successfully, business type needs to be taken into account, and the scheme needs to develop a commercial landscape promoting large-scale growth of small to medium sized enterprises (SMEs) (Genovese et al., 2013; Killip, 2012). Assessing the ways in which policies interact with the EERS sector forms the focus of this research.

1.6 Motivation for Research

Due to the researcher having worked personally within the UK EERS sector and in particular in preparing a business to operate as a GD related supply chain member, the research motivation originated from a desire to assess how other sector individuals had experienced a similar role, and what processes could improve this experience. Taking a step back however, the original motivation for entering the retrofit industry in general was due to an acknowledgement that renewable energy increases although essential, need to be coupled with an efficient attitude to energy consumption. Domestic property energy efficiency also appeared to be a good way in which to provide deprived and low income households with a positive and logical way in which to save money. This financial driver was also related to the fact that as an employee of the EERS sector, retrofit as a commercial strategy is acknowledged to provide a highly rewarding career. Therefore, in contributing to policy

learning, the belief is that employment levels could be increased, due to the labour intensive nature of the process. Plus, this employment is considered accessible to all types of individuals with all types of training levels and experiences, across all areas of the country. This ensures maximum positive impact from policies, as opposed to schemes which have larger impacts in urban centres for instance.

1.7 Summary

In overview this research has been motivated by a view that retrofit activity increases can save carbon, homeowner's and tenant's money, boost economic activity, along with providing high levels of employment increases. In focusing in on the private sector involvement of carrying out retrofit works, the standpoint here is to assess practically how policy and the EERS sector can operate optimally together. Conclusions therefore are anticipated to provide insight into possible alterations to the present discourse and provide routes to increased retrofit levels.

1.8 Published Research Outputs

Throughout the process of completing this research, additional conference and journal papers have been produced. Summary details of the outputs can be found below (table 1). These publications detail findings from different stages of the overall research scheme, with the ENHR conference paper presenting initial policy documentation analysis findings, the ECEEE paper offering a preliminary comparison of different policy mechanisms, and the following three papers using different sets of data to provide analysis as to policy performance.

Table 1: Additional research contributions.

Publication	**Contribution**
Gooding, L. and Gul, M. S. (2014). Breaking Down Barriers to Achieve UK Domestic Energy Efficient Retrofit at Scale; Lessons To Be Learnt From The German Policy Landscape. Paper to 2014 ENHR Conference.	This paper details the reasoning behind present policy designs to increase EERS sector capacity within the GD. Key findings suggest EERS expansion may be most successful if policy mechanisms are designed more holistically; both UK and German case studies show single strategy policies have their disadvantages.
Gooding, L. and Gul, M. S. (2015). Understanding the effectiveness of the Green Deal; a study of policy impact on the retrofit supply chain. *ECEEE Summer Study 2015.*	Different types of impact generated by the GD upon the supply chain are investigated, and the rate at which barriers to growth are being removed is examined. Findings aid the understanding of what barriers are hindering businesses presently, and to what extent they could be reduced into the future. These results contribute to ongoing policy learning from ground level sources, with insight into the effectiveness of policy upon the financial, operational and growth characteristics of businesses.
Gooding, L. and Gul, M. S. (2016). Energy efficiency retrofitting services supply chains: A review of evolving demands from housing policy. *Energy Strategy Reviews*, *11*, 29-40.	This review evaluates this GD policy landscape in relation to the requirement of EERS sector expansion. Key findings suggest EERS expansion is most successful if policies are designed more holistically; UK policies show strategies which focus on simply the property and not the occupants have their disadvantages.
Gooding, L. and Gul, M. S. (2016). Analysis of the growth characteristics of the UK's Energy Efficiency Retrofitting Services (EERS) sector; lessons to be learnt from Germany. Paper to 2016 WSED Conference in Wels, Austria.	This research evaluates the present EERS sector landscape in relation to addressing the need for retrofit action increase. Key findings suggest that an emphasis is required on training to enable an increase in the capabilities of the EERS sector, and to also enable a heightening of the quality and variety of retrofit work delivered. Furthermore, findings detail the need for an understanding of how EERS sector business should communicate with end users, to ensure that the sector adopts a professional approach to all areas of operation.
Gooding, L., & Gul, M. S. (2017). Achieving growth within the UK's Domestic Energy Efficiency Retrofitting Services sector, practitioner experiences and strategies moving forward.*Energy Policy*, *105*, 173-182.	This research assesses the present EERS sector landscape and the addressing of the need for increased retrofit activity. Key findings suggest that UK retrofit practitioners were unprepared to professionally deal with the expectation of the GD, in terms of business administration and also dealing with the policy itself. Moving forward an emphasis is suggested which focused on training, to enable an increase in EERS sector capabilities, and to also enable an improvement of the quality and variety of work completed.

Chapter 2. Literature Review: the UK EERS sector and policy interaction

The aim of this chapter is to offer a review of a critical nature, covering the varying literatures connected to retrofit delivery business networks, and related policies designed to assist in producing retrofit at scale.

Consequently, the literature review starts with an overview of the practice of domestic low carbon retrofit, followed by government policies designed to increase the level of retrofit taking place. This review then continues by detailing the characteristics of the EERS sectors, in both the UK and Germany. Therefore, this chapter is a forerunner to chapter 3, within which an introduction to the analytical framework of this research is detailed, from which the methodology results designed to tackle the aim and objectives at the end of chapter 1.

2.1. Retrofitting the UK housing stock

Within the larger context of domestic retrofit, this research focuses specifically on the aspect of the private sector delivery of retrofit schemes of work, and related government incentive policies. The scope of this research is restricted to the UK, but there is the acknowledgement that the research could produce findings which are applicable within other developed nations. One country of particular note here is Germany, which has been selected as a comparison nation and is similar both climatically and in terms of housing stock.

2.1.1 The challenge of retrofitting the UK housing stock

The general construction industry is the largest global user of materials, along with the fact that buildings are the biggest single use energy consumer (Giesekam et al., 2016). Moreover, buildings produce 19% of all global greenhouse gas (GHG) emissions (Intergovernmental Panel on Climate Change (IPCC), 2014). This level of built environment carbon emissions, offers a key reason why UK government is explored to produce policies and concentrate resources to reduce the level of emissions, along with removing energy insecurity risks for the UK public (Dixon & Eames, 2013; Kelly, 2010).

The potential positive impact for retrofitting is also additionally emphasised by the fact that overall there is a very low replacement rate for UK properties; meaning that less than 1% of domestic homes are being replaced by new builds yearly (DECC, 2012a) with up to 80% of properties presently occupied still being inhabited in 2050 (Kelly 2009), further highlight the need for retrofit increases.

As such, this research is centred on the identification of improvements of market condition within the UK, to help accelerate the rate of retrofit activity being completed by the EERS sector, and reduce the scale of the challenge at hand.

2.2 The Energy Efficiency Retrofitting Services (EERS) Sector

The EERS sector carries out retrofit construction activities, which are often viewed as the implementation of energy saving technology and materials within a dwelling. This view has now, to an extent, been superseded by viewing retrofit processes as social-technical systems, whereby human behavioral characteristics and cultural factors are as much of a part of the sector as the technical measures (Gram-Hanssen, 2014; Pilkington et al., 2009). The interaction of the physical dwelling and the people who retrofit and live within the building form a complicated network of forces, which highly influence each other before, during and after a retrofit project.

The EERS sector interacts with the existing housing stock in a variety of different ways (Genovese et al, 2013). These methods enabling retrofit include the design and construction of properties and extensions, the installation of low carbon materials and technologies, the maintenance of energy efficient equipment and also the management of industrial processes. Stakeholders undertaking these processes include individuals in both the private and public sectors, and can include government organisations, construction companies, contractors, engineers, architects, designers, suppliers etc. In general there has been a deficiency of studies focusing on the specific industry and policy interaction of the EERS sector, mainly due to the fact the sector has previously been only identified as a sub division of the general construction industry (Genovese et al., 2013). This more wide reaching industry implements property improvements and new builds in its widest sense, ranging from ongoing maintenance, and cosmetic improvements, to design and new build construction.

Peer reviewed journal papers covering the EERS sector literature have started to emerge over the past few years (DTI/DEFRA, 2006; Goldman et al., 2010) (table 2), and can be attributed to the rise in demand for measures and also the development of government policies and initiatives applicable to the sector. Past studies show (DTZ, 2009; Goldman et al., 2010) that the majority of businesses operating within the sector are small, with 10 or fewer employees. This small scale of operation in turn means retrofit projects are, in the main conducted on an individual basis. This individual basis of operation deters larger businesses from entering the

sector, as economies of scale are hard to generate, and heterogeneous projects require significant management and administration costs (Mundaca, 2007). This absence of large-scale business investment may be due to the lack of government funded initiatives increasing demand, or due to the highly fragmented state of the sector (Genovese et al., 2013). Either way, without demand, projects cannot be generated which provide opportunities for innovation into how technologies and techniques can be devised to apply to numerous different properties and circumstances. This therefore creates an environment where a lack of initial investment prevents a swelling of further larger scale investment.

Table 2: Existing literature covering the EERS sector, adapted from Genovese et al., 2013.

Authors	**Year**	**Key Findings**	**Review**
Genovese et al.	2013	EERS sector supply chains need to be configured correctly to maximise the benefit to both public and private organisations.	This article focuses in on assessing the scope and capabilities of the EERS sector via evaluating different businesses operating within the sector. Stakeholder theory is used to assess the business and determine the extent to which the company can supply retrofit at scale, and which types of business is best suited to different projects. The research offered a practical insight into the task of optimising the EERS sector, however limited emphasis is paid to strategies of improving the sector, and also key aspects of the industry such as power fulcra, key personnel or organisation type was not detailed, even though stakeholder theory was used. What can be seen when comparing this research is that the focusing on optimising the commercial aspect of the EERS is clear, it is not enough to simply change policy incentive schemes and hope the existing network of practitioners will deliver retrofit improvements, instead significant changes are required to produce an innovative proactive sector, as is mirrored in the findings here.
Goldman et al.	2010	Study into the size of the EERS sector in the UK, established the need for workforce up scaling to meet demand.	This study researched using interviews the level of training and jobs required to meet retrofit targets into the future. Training in particular was focused upon as a key pathway to meet targets, with concepts such as retrofit manager implementation, university level courses, tradesperson training and short course training all playing a role in upskilling the EERS sector. Although interviews detailed an in depth way into which findings in training strategies could emerge, it was also considered that a cost benefit analysis of training investments may have also been useful, to take the suggestions of changes and offer added depth as to their worth. Nevertheless the findings of training forming a key area of attention to enable progress.
DTZ	2009	EERS sector forms an important part of the UK south west regional economy. The sector in the south west outperforms the EERS in other UK regions.	Using a case study of the South West, this research highlights the role of networks operating to generate substantial retrofit advances. Highlighted in this research, the concept of sharing knowledge and expertise is important in promoting large scale retrofit. However this paper takes this concept further by carrying out a cost benefit analysis of the sector in terms of how much money it brings into an areas, and the benefits provided. This is considered a value insight, and concretes the value of retrofit in not simply carbon terms. This research in this sense provides a greater depth in terms of connecting retrofit activity to financial performance in a specific geographical area than this research does. However, there are also potential issues with the research only considering EERS sector practitioners and not including more traditional construction professionals carrying out retrofit.
DTI/DEFRA	2006	The EERS sector within the UK, estimated to be worth £2bn.	In a similar manner to the DTZ article, this publication also highlights the specific cost benefit of retrofit. From this focus the economic gain to be generated by retrofit increases is detailed, which in turn offers an indication of the multiple benefits on offer via the incentive policies. This area is something which is not considered within the scope of this study, however the way in which financial gain can be made via policy intervention is an area highlighted by participants within this research.
Vine	2005	Study of the present barriers halting EERS sector expansion within the EU.	In a similar manner to this research this publication viewed different innovative organisation and business types within the EU as they attempt to reduce the level of domestic energy consumption. This displays the wide array in which retrofit activity can occur, a factor parallel with findings of this research. However what differs is the in depth case study approach used by Vine, a research strategy which could have offered an in depth expansion of the findings made here, however this route was not considered an option due to the constraints of resources and time here.

Businesses operating within the sector may do so exclusively, whilst others may have operations external to the sector (engineering or design companies). This wide variety of sector actors, operating on the fringe of standard practices means that it has yet to be fully defined as a standalone industry. This reason offers rationale for the definition of the subject arena as the EERS sector rather than industry (Genovese et al., 2013). This effective overlapping of business means that there is potentially a level of substitution within the EERS sector for products and services already existent in the present construction industry. In addition, as the focus of the EERS sector is on upgrading existing products and processes with more energy efficiency solutions, many of the jobs within the sector are not new, but have instead evolved from an occupation providing a less energy efficient service or product. This therefore means the EERS sector and 'green' jobs in general are either created, transformed or retained (Ürge-Vorsatz et al., 2016). For the UK, the level of increase in EERS activity needed to meet carbon reduction targets means a large amount of job creation is required, to enable extra capacity (Owen, 2015).

Vine, (2005) via an international survey took a more general stance in evaluating the EERS sector activity across the EU. Although EERS sectors differ from country to country, common forces halting development were identified. Included within this list is information inaccuracy barriers, public procurement protocols blocking mass engagement with energy efficiency, reliability concerns preventing large scale investment in research and development, administration costs making all but the largest project unviable, and the limited commitment and understanding of financial institutions to commit funds. As the majority of businesses operating within the EERS sector are relatively small, these barriers harbour large challenges (Tonn and Peretz, 2007).

The existing literature on the EERS sector shows a gap whereby researchers have yet to review the development of the industry in response to policy (table 2); this is where this research aims to fill this gap by assessing the challenges of sector development and the stance taken by policymakers. Furthermore, existing literature has yet to investigate the EERS sector in terms of how practitioners are attempting to increase retrofit at an accelerated rate, and reduced the limitations of finance and organisation structure on sector growth (table 2).

2.2.1 Characterising the EERS Sector

The market supply chain for energy efficiency improvements is comprised of a large variety of businesses and institutions which provide services to different end user arenas, including industrial, commercial and residential arenas. The actual supply chain covers activities including product research and development, manufacture, wholesaling, distribution and implementation (design, construction, maintenance) (Goldman, 2010). All processes and actors involved within a retrofit project from its conception to disposal are taken into account within the supply chain, adding to the level of complexity incentive policies have to deal with. This research intends to consider different types of professions within the EERS sector, assessing how they work with policy mechanisms to increase retrofit activity. This evaluation of the character of sampled EERS sector businesses takes place via the investigation of commercial operation attributes, providing a background as to the different types of companies operating within the sector.

2.2.2 Innovation within the EERS sector

Innovation takes place in two different ways within the sector, firstly there is product innovation. This can entail the conception of a new product which can deliver enhanced efficiency. A prime example of this is the Camden Council/ WHISCERS project which saw the delivery of an on-site laser cutting technique to enhance the effectiveness of internal wall insulation (Technology Strategy Board, 2012). This new product tackled the bespoke nature of retrofit project by enabling the efficient application of insulation boards to particular room sizes. This increased the applicability of the insulation to different projects and also efficiency of delivery.

The second method of innovation is that of services and process change. In the case of the changing EERS sector, a key mechanism to increase the effectiveness of delivery is to co-ordinate knowledge effectively. This may mean the placement of an individual to project manage a retrofit scheme of works, to ensure tradespeople, technology and residents operate in the most effective way. This coordinator can provide planning, delivery and handover knowledge, minimising delays and costly reworking of measures (Technology Strategy Board, 2012).

2.2.3 EERS Sector supply chains

Building upon the fact that EERS sector activities are not distinct from traditional construction activities, the supply chain within the sector focusses on the design, construction and maintenance of energy efficient measures. As construction projects are heterogeneous and un-standardized, each project has its own characteristics and specification; this in turn makes project bundling and creating economies of scale difficult. The supply chains are made up of businesses and organisations involved in each and every process from raw material extraction to the ultimate disposal of the building or product (Adeyemi et al., 2014). Supply chains within the EERS sector and the construction industry in general have been created for profitable and practical reasons, resulting in a complexity which is determined by a multitude of interactions and dependencies (Dunphy et al., 2013). Supply chain complexity is further exacerbated by many supply chains being formulated to order, and put together for a singular project, due to market unpredictability (Yu et al., 2009). This unpredictability defines the project based nature of the industry as there is an inherent lack of a continuing relationship between many stakeholders. Consequently understanding these conditions in which EERS sector projects occur is of paramount importance when attempting to create policy which facilitates retrofit activity growth.

The vast network of stakeholders is of key interest here, as an understanding of the way in which different businesses and organisations form their values, means an assessment of how key individuals or 'power fulcra' respond to policy (Genovese et al., 2013). As the EERS sector is still fostering an understanding of how to position itself successfully for retrofit at scale, discovering how innovative forward thinkers are strategizing is of importance for a commercial learning process to occur.

2.2.4 Challenges to the UK EERS sector

The UK EERS sector has been estimated to be worth £17.6 billion (2010/11) (DECC, 2012a), and includes business activities from design, to manufacture, to project management. The Technology Strategy Board (TSB) carried out a review of the *Retrofit for the Future* projects and brought forward the following observations and challenges regarding EERS sector activities in practice (TSB, 2013) (table 3):

Table 3: Challenges to the expansion of the EERS Sector, identified via the Retrofit for the Future projects. (TSB, 2009).

Challenges to the EERS Sector	The embryonic nature of the industry means a lack of competition and therefore high prices for high specification products.
	Due to limited economies of scale of product suppliers, projects were subject to high price volatility, particularly in goods such as innovative insulation or glazing products.
	Delays in product delivery due to under-developed supply chain.
	Products not meeting their stated performance capabilities.
	Lack of UK suppliers for overseas goods.
	Concerns with the EERS sector were prevalent regarding the availability of skilled and experienced tradespeople.
	Difficulty in determining respective roles within an integrated delivery team.
	Need to monitor and oversee works to ensure quality when installing measure, particularly within products such as internal wall insulation.

These barriers detail some of the ways in which retrofit action is hindered, and identify specific concepts which have impacted the sample group within the TSB study (TSB, 2009). In designing policy to increase the level of energy efficiency upgrades, mechanisms are needed to not only overcome barriers (table 3) which cause the *energy efficiency gap*, but also maximise the economic potential of the sector (Golove and Eto, 1996). Retrofit policies have in the main been made up of incentive schemes, which contain an element of government subsidisation or support to encourage retrofit action (historical retrofit policies detailed in section 2.4.1), however the GD policy implemented by the UK government in 2013 comprised of a reduction in the level of funding and support. This means that into the future, there is the potential for the EERS sector to be placed in this situation again, where policy implementation is down to businesses, and the success of the scheme is therefore reliant upon the private sector to finance, deliver and manage the policies emplaced (Guertler, 2012).

2.2.5 The task of increasing capacity of the EERS sector

Capacity expansion within the EERS sector involves the assurance that machinery, equipment, materials, production processes, investment and the skill base are in place to absorb sector growth. In addition, for capacity expansion to succeed within the retrofit industry, the lack of organisational learning has to be considered (Chaston et al., 1999), learning which results from experience. Williams (1992), posits that this learning and advancing of the skills base can have significant advantages in terms of offering more cost reductions than technological advances provided alone, via increased efficiency in delivery. However, in business sectors where extensive levels of expertise is not yet present, mechanisms such as introductory subsidies or cashback schemes could offset higher initial costs encountered by private business. These initial costs are encountered due to delivery inefficiencies, caused by ongoing learning processes and expertise development.

In addition to the issue of expertise evolution within the retrofit industry, technological innovation, and the capabilities of materials and installed products are also still developing. Therefore, in contrast to traditional capacity expansion which assumes market existence to facilitate additional capacity, the EERS sector needs to raise public interest and capacity simultaneously (Isaksson et al, 2010). To generate this public interest the EERS sector needs to furnish public information streams with tailored knowledge of the sectors products and services. As stated by Isaksson et al. (2010) there is a general lack of public retrofit understanding, with 70% of homeowners in 2006 stating their knowledge of sustainability as minimal or non-existent.

The emerging nature of the retrofit sector also means businesses have to be aware of new business entrants adding to the level of competition within the market. Therefore in expanding capacity, minimisation of risk needs to be considered by protecting the niche in which the business operates (Rogers, 2003).

To assist the advancement and growth of the EERS sector, governments intervene to accelerate rates of change and increase adoption of new processes and products.

2.3 EERS Sector Literature Review conclusions

The following themes and concepts are factors which are resultant from the literature review into the EERS sector and therefore place existing research under assessment to produce a contribution to knowledge. In particular these novel insights offer an expansion of the barriers identified in table 3, and characterise different concepts of limitations to sector growth.

By bringing together research by the TSB (2009) (table 3), and researching further general barriers limiting retrofit at scale, the following categories have been identified and compiled:

-Barriers which are limiting demand for EERS sector services.

-Barriers which are inhibiting the growth of the sector and limiting new business entrants into the sector to enable the growth in capacity.

2.3.1 Barriers limiting demand for EERS sector services.

Imperfect information (Policies and the EERS sector need to provide correct information)

Imperfect information is the notion that consumers often only have limited access to accurate information regarding the market, technology and how their energy use could change. This information deficit leads to investment barriers (Sanstad and Howarth, 1994). Imperfect information can arise in several forms, including insufficient information regarding factors such as energy performance and technological developments, inaccurate information due to a lack of transparency from market actors, and the fact that information can be costly to acquire (Ürge-Vorsatz et al., 2007).

Form of information

Homeowners, landlords and tenants may be limited in their enthusiasm for energy efficiency information and therefore may only take in certain media formats detailing housing retrofit, and not search out different sources of data (Rohdin et al., 2007). Information intake would be increased if information forms were tailored to appeal to a specific section of society, or presented in a way which the individual can relate (Stern and Aronson, 1984).

Credibility and trust

The level of information intake by end users and consumers is also dependent on the perceived level of trust that can be placed in the information provider. Individuals or organisations which can provide a personal information service, which is not driven by a financial return are useful places to generate relationships leading to enhanced energy efficiency (Ramirez et al., 2005; Stern and Aronson, 1984).

Inertia

Entrenched routines and habits may also lead to the energy efficiency gap, as people are programmed to reduce risk and therefore create routines. These routines are difficult to break and may cause issues of energy inefficiency to be simply avoided or ignored (Stern and Aronson, 1984).

Bounded rationality

Bounded rationality, is the concept that individuals do not always act rationally. This can cause energy efficiency measures to not be undertaken, even though improvements may be economically profitable and a rational choice to make (Gillingham et al., 2012). The first cause of bounded rationality is the fact that energy efficiency decisions require individuals to solve problems of optimisation, to gain the lowest cost energy provision (Stanstad and Howarth, 1994). The complexity of these decisions causes the rational choice of action to become unclear. The second issue causing bounded rationality is the factor that multiple actors within a household or organisation inhibit a rational decision to be made. Thirdly, humans do not always act with rationality and purely with information; rather individuals may act on the basis of a hunch or by rule of thumb (Stern and Aronson, 1984).

Principal agent problem

The principle-agent relationship exists due to a lack of trust between two parties. This mistrust exists due to the characteristics of a relationship or the transaction taking place. The landlord-tenant problem is an example of the split incentive inherent within principle agent relationships, which leads to a lack of willingness to invest in retrofit measures (Jaffe and Stavins, 1994). The split incentive is the concept that the

individual using the energy is not the individual responsible for the upkeep or energy efficiency improvements of the property. To encourage demand and also EERS capacity increase, policy needs to provide incentives to both sides of a principal agent relationship.

Building Heterogeneity

The gap between possible energy efficiency and actual achieved efficiency may also be due to existing buildings being extremely heterogeneous. This factor causes three issues to the EERS; firstly a high level of expertise is needed to tailor solutions to different property types. Secondly, economies of scale are difficult to generate as each property requires different measures. Thirdly, high levels of investment are needed to research and develop solutions which can cater for a wide range of different property types (Jaffe and Stavins, 1994).

The first five barriers described are inherent to human consciousness, the fact that without tailored, transparent, readily available explicit information, from a trust worthy source, demand and industry expansion will be difficult to generate. The last two barriers are inherent to the housing characteristics of the UK. Policy, in tackling these issues needs to generate aligned incentives to appeal to both landlord and tenants, and will also have to provide conditions for innovation, to aid effective retrofitting of the wide ranging UK property types.

2.3.2 Barriers inhibiting the growth of the sector and limiting new business entrants into the industry to enable the growth in capacity

The following barriers are factors which have to be considered by all potential businesses when setting up, or growing an operation. It is important to appreciate here that these barriers have a high impact on businesses, as future operation conditions within the sector are unknown.

Transaction Costs and Access to Capital

DeCanio (1998), states that TCs are key factors hampering the growth of businesses. TCs can occur in various forms, from the cost of sourcing information, setting up the

supply network, to gaining business contracts (Mundaca, 2007). These processes detract from the level of profit achievable and therefore limit investment.

TCs are unavoidable and in many cases unanticipated, and emerge from contracting processes intrinsic to the delivery of services or products (Coase, 1960). In the arenas of technology and in turn the EERS sector, TCs result in barriers to the uptake of new innovations, these costs can occur before the provision of goods or services, in terms of setup and arrangements costs, they can also occur post retrofit in monitoring associated costs (Matthews, 1986). The resultant effect of TCs is that it makes emergent processes and technologies prohibitively more expensive than products already in use. As housing uses such a large percentage of energy globally (31%) (Urge-Vorsatz et al., 2012), there is a large potential for efficiency improvements meaning the full effects of TCs need to be better understood.

Multiple sources of TCs have been acknowledged, with their effects being felt for the entire duration of a project's life, including the planning, delivery and aftercare phases. In essence TCs can be characterized as areas where funding is needed for information gathering, negotiation, accreditation and ongoing monitoring (Mundaca et al., 2011). In the specific arena of construction, TCs result from the processes involved in project preparation, finance searching, construction supply chain searching and negotiation, plus ongoing post project monitoring (Mundaca and Neij, 2006). Combined, these costs deter investment in energy efficiency measures, as TCs can form 30% of the final installed cost of cavity wall insulation, and 10% of lighting improvements (Mundaca, 2007). Even with percentage estimates such as these however, the level of uncertainty around TCs is still high. This lack of accuracy is caused by a lack of data regarding technological performance, data source reliability and the unproven nature of monitoring and cost quantification (Mundaca, 2007).

The overview of TCs from this research, is that the scale of TC impact is governed by a variety of factors, which can stem from internal factors, such as business culture and implementation processes, and also external factors such as type of contract, information availability, policy landscapes and inherent trust between participants.

The complex makeup of the construction sector, with its multiple stakeholders and connections means TCs are relatively high (Winch, 1989) compared to other industries. Therefore, the introduction of new energy efficient measures into the industry may contribute to the amount of TCs faced, which are not anticipated. Nevertheless, there has been some progress in reducing the impact of TC uncertainty within the industry. For instance at management level, standardisation of processes, bundling of schemes, and accounting for the full life cycle costs of a project can reduce the uncertainty of TCs. In addition, clarity within legal frameworks offers the potential for energy efficiency measure diffusion. Legal stipulations supporting project monitoring, and product verification, along with accreditation and information provision, combat against the impacts of TCs (Kiss and Mundaca, 2013).

Following the issue of TCs is the fact that capital generation to set up a retrofit service or product is prohibitive. The fact that the sector is still emerging exacerbates this problem as investors do not have a prior experience of successful returns (Hirst and Brown, 1990).

For a capacity increase in the EERS sector and for new business enterprises to establish there is a need for policy to generate financial conditions limiting the risk to investors, and providing arenas to encourage innovation developments in products and processes (Jaffe and Stavins, 1995). Furthermore, to enable business to setup operations, and provide local delivery of policy, the government must provide a framework of how to manage the quality of work carried out and also the distribution of liability effectively. This framework needs to strike a balance between protecting customers with ‘red tape’ and also limiting the administrative load on businesses, thereby restricting TC impact and encourage retrofit uptake.

Organisational barriers

The growth rate of the EERS sector means the need to identify niches and predict downstream capacity and potential future competition is important. In addition, as experienced actors are lacking (Owen et al., 2014); the need for innovation and problem solving is high. With a business culture that does not permit these things,

profiting from operating within the EERS sector is deemed difficult (O'Keeffe et al., 2016).

For a capacity increase in the EERS sector and for new business enterprises to establish, there is a need for policy to intervene and tackle the above two barrier areas. Policy will need to generate financial conditions limiting the risk to investors, and providing arenas and funds to encourage innovation developments in products and processes. Furthermore, to enable SMEs (Small to Medium sized enterprises) to setup operations, and provide local delivery of policy, the government must provide a framework to bundle finance available to smaller businesses. This would prevent a monopolised market, due to larger companies dominating the advantage of economies of scale (Koh et al., 2012; O'Keeffe et al., 2016).

The network of stakeholders and individuals within organisations forms one side of this research. This stems from the need to assess how different stakeholders operate and work together to provide a method of market expansion, beyond the simplistic increase of technological advancement and financial investment. Therefore, by looking into the organisation barriers and stakeholder formations, important indications of how polices work in relation to the human factor of the industry can be gained. This stakeholder analysis will take place alongside the assessment of TCs to enable a holistic look into policies and EERS sector capacity increases.

These barriers highlight the complexity of the challenge to enable retrofit at scale and in turn identify the reasoning for continuing policy learning, to ensure intelligent implementation of policy schemes. Plus, using these categories of supply chain barriers, an informed investigation strategy can be generated, to ensure a comprehensive analysis of policy/EERS sector interactions.

Further details regarding the barriers to retrofit identified via this literature review can be found within the conference paper Gooding and Gul (2014).

This next section will look into the background of policy theory and design, along with the concept of policy learning and the route of inquiry employed here.

2.4 EERS sector related policy theory

Recent years have seen the concept of economic growth linked with sustainable development within the policymaking arena. With this unprecedented development of interest into growth which is sustainable, the prevalence of the term 'green growth' is high (Clark, 2014). Green growth is determined as economic growth which also provides a substantial level of environmental protection (Hallegatte et al., 2012). The World Bank (2012a) states that green growth is development which can use natural resources efficiently, whilst also minimising pollution, and generating resilience to natural hazards and disasters. However, the OECD (2011) focuses more on sustainability and natural asset provision than resilience. Although focusing on different key points, the commonality is that they assert that present business activities are not meeting the necessary levels of environmental protection.

This 'green growth' was, before 2008 not a priority within economic organisations. However, the World Bank (World Bank 2012a, 2012b), the OECD (2012), the GGGI (2012) and the United Nations (UNEP 2011) have now all joined together to form the Green Growth Knowledge Platform, to initiate research into the concept of economic growth and sustainability coupling (World Bank 2012b). Via this platform, the G20 countries have formally committed themselves to the promotion of 'green growth, with the 'Rio+20' United Nations Summit focusing in on the 'green economy,' (UNCSD, 2012). This in turn was adopted by the UK Conservative and Liberal Democrat coalition government during their period in office from 2010-2015 (Clark, 2014; Green Growth Group, 2013).

This section of the literature review therefore seeks to position the notion of 'green growth' within EERS sector policy making practice. In particular attention is paid to how different policy discourses can achieve the triple bottom line of economic growth along with environmental protection or the effective use of natural resources, plus the prioritisation of societal needs including employment and community issue awareness. Green growth is considered here as the key reason for the position of supporting policies for the EERS sector. Without a government push to bring prosperous and sustainable societies forward, policy assistance for areas such as the EERS sector would not take place.

2.4.1 Achieving Green Growth, the role of policy

The theory of economic growth working with environmental aims is not a recent development. In fact the central focus of the concept was first brought to the fore via sustainable development within the Brundtland Report (1987). Green growth is now being termed as a policy based method to achieve specific factors within the general concept of sustainable development, rather than a replacement for it (OECD 2011, UNEP 2011, World Bank 2012b).

In recent years, action to work towards sustainable development goals has slowed (Robinson, 2004). In many ways sustainable development has become too much of a staple within government agendas; that it has lost some of its impact to provide motivation to initiate radical change (Sneddon et al., 2006). Sustainable development has traditionally been portrayed as a concept of limiting consumption to preserve natural assets for future generations (Ekins, 1993). However, the concept has been stated to have a lack of focus and tries to address too many different themes (OECD, 2011), meaning it has proved difficult to frame by policy makers. Consequently, green growth is a politically attractive way in which to increase the economic activity of a nation whilst utilising business innovation, to simultaneously protect the environment. It is therefore considered here that policies aimed at achieving green growth, can provide a succinctness and clarity for end users and industry practitioners, which the general sustainable development discourse has failed to achieve.

In the case of the EERS sector, this linking of environmental protection and sector prosperity, provides a central driver producing an arena of high employment and business activity, the aim of which is to drive a wide network of business and individuals innovating to reduce the cost of running a property and provide a ‘green revolution’ as termed by the 2010-2015 Coalition Government (Dowson et al., 2012).

2.4.2 Green Growth: a way out of a financial recession

This green revolution stated by the Coalition Government was coined to address the fact that in recent years the UK economy has been in a recession and with green growth this recession could be halted (Clark, 2014; Hallegatte et al., 2012; Ki-Moon and Gore, 2009). The crux of the government assertion is that with increased economic activity via green growth, increased

employment opportunities would be made available, and therefore in turn this would increase the demand for goods and services in general (Ekins, 1993).

During a recession, a key government role is to replace the demand lost due to private sector activity shrinking, and therefore retain overall demand. This process then aids the increase in employment figures and overall national spending power (Jacobs, 2012). Within Europe over the period 2008-9, the financial stimuli used to sustain economic activity related to 'green' schemes post-recession commencement, was around $23bn, or 60% of the general EU stimulus budget (Barbier, 2010). Although spending to increase economic activity does not necessarily have to be 'green' related, it does offer incentives to invest that other areas do not. A particular thought process defending the choice of green growth stimulus spending is that in areas where spending is planned, bringing that spending forward will complete a project which needs completing anyway. Projects such as upgrading the UK's aging power stations, or inefficient housing stock can begin, with the aid of recession enabled cheap labour, materials and finance (Bowen, 2009). This research therefore has foundations in the concept that, via effective green growth policies, the government can generate a cost and time saving when completing large projects, which would not be possible in recession free periods.

Government green growth stimuli could be funded via taxation and regulation policies, which drive businesses into a position which prioritises green growth and sustainable development (Zenghelis, 2012). Furthermore, a green growth policy focus and the related public spending can bring about greater short term economic growth, when compared to general economic incentives. This is due to the fact that most environmental improvement schemes, housing retrofit included, are highly labour intensive, therefore offering a higher rate of employment growth than non-green stimulus schemes (Green New Deal Group, 2008). Therefore, domestic housing retrofit within the EERS sector is a key exemplar promoting the use of green growth policy strategies. Many of the procedures involved in bringing housing up to a higher efficiency level involves numerous relatively low skilled processes, requiring labour across the entire geography of a nation, unlike other schemes such as wind turbines or solar panels installation (Jacobs, 2012). Furthermore, retrofitting the housing stock brings energy cost savings to society in general, freeing up finance within businesses as well as individual households to spend and stimulate the economy further (Roland-Holst, 2008).

Although critics to public intervention to correct market failing, state that the market conditions falsify the market and cause delays in private sector recovery (Moore, 2011), the fact remains that as a short term intervention, government schemes can boost employment and therefore economic prosperity (Barbier, 2011). Even in a short term scenario, the concept within this research is that with effective policies, the level of carbon savings and economic recovery could be high. This is related to the scale of the size of the retrofit challenge in terms of property numbers and also monetary figures. Therefore, in optimising policies, even for the shortest of political cycles, benefits are considered to be high.

2.4.3 Government policy to provide growth and correct market failings

The second key crux promoting interventionist policy, alongside being a way out of a recession, is that policy can accelerate sector growth (Barbier, 2011). Economic prosperity and output is the result of combining finance, human capital, and technology. A boosting of output can be attributed to an increase in general of these components or an increase in productivity. In green growth theory, the physical environment is considered an asset and source of capital; it provides resources, processes waste and sustains life (Jacobs, 2012). In valuing the natural environment accurately in line with these views of capital, its full value far outweighs the value it has been assigned in traditional economic assessments (Spangenberg, 2012). In factoring in the full value of the natural environment, green growth policies can correct this market failure of undervaluation. This accurate pricing of the natural assets then asserts more financial value to processes intended to protect the environment from degradation, such as domestic property retrofitting to reduce carbon emissions. In producing effective conditions to promote the expansion of the EERS sector, more value can be added to the sector and in turn promote the further growth of other sustainable business enterprise.

Another market failing green growth policies can correct is that of an under-investment in research and development and network creation. This under-investment is due to the benefits of investment not being exclusively experienced by the investing party; therefore, commercial investment is thwarted due to fears of giving competitors an advantage from internal investments (Aghion and Howitt, 1992). Forming a green growth policy with an aim to address under-investment could bring additional benefits of innovation and positive growth. This could be via mechanisms of industrial clustering and research and development tax rebates (Porter and Linde, 1995). Prioritising green growth can also bring fuel security, plus a barrier to energy price volatility via increasing the negawatt (unused energy via

heightened efficiency) (Joskow and Marron, 1992), and also the promotion of non-fossil fuel energy types (Rozenborg, 2010). In these ways, the concept of green growth acts as an encouraging force to gain collaboration between environmental policy prioritising protection and economic development in general.

2.4.4 Green Growth and Employment

The third crux promoting green growth and policy intervention within the environmental private sector is that it can increase the number of jobs within environmental businesses (Bowen, 2011). Globally the general environmental sector is worth around $5bn and supports via employment, 28 million people (Department of Business, Innovation and Skills, 2013). It is worth mentioning of course that environmental jobs may be being created due to factors aside from policy interventions; jobs may be evolving naturally from traditional sector positions (Jacobs, 2012). Therefore, the following points are needed, to validate the claim that policy is needed to grow the number of employment opportunities with an environmental sector.

Firstly, countries which have initiated an environmental policy roster within their governance, have given their respective environmental sectors an advantage over competing countries. When pushed, environmental sectors provide new services and products via innovation; this increases domestic and international business trade levels (Porter and Linde, 1995). When a nation can mobilise via policy incentives, to be the first into an industry, successes such as the Danish wind power or German solar sector excellence, are possible (Ambec, 2011). This innovative action, resulting in an advantage over competing countries can only happen via a policy push to accelerate industry development, at a faster rate than other nations. Therefore, the need within the UK to prioritize retrofit policy could aid the growth of an internationally leading industry, increasing the nation's economic and carbon saving status.

Secondly, green growth has been considered as a catalyst for development of national economies as a whole. In other words, increases in the extent and economic power of the environmental industry as a whole, could provide a 'new industrial revolution' (Stern and Rydge, 2012). Similar to previous industrial revolutions, the growth of the environment sector could harbour a large level of innovation, impacting lifestyles and the economy in

general. New methods of manufacturing, and new techniques of saving energy and processing waste, have the potential to form the foundations of a low energy, low carbon economy (Perez, 2010). Furthermore, this research, as it considers the EERS sector as an entire entity, looks into the complete lifecycle of the UK's housing stock and the stakeholders and organisations involved in upgrading properties. In doing so, the assessment looks at a wide range of enterprises and professions, in turn casting light upon the potential for a new low carbon economy as a whole.

2.4.5 The role of policy in aiding the advancement of sustainability

The level of appropriate policy intervention within the environmental sector and thus the EERS sector has been shown to be debated, via the different levels of policy incentives and prioritisation within recent retrofit policy schemes. Within this debate, two factors are clear regarding the effectiveness of policy to promote green growth.

Firstly, the specific formation of a policy landscape is of high importance; history dictates that some policies may indeed promote the environmental sector, whilst there is also a high chance that other policies will act as constraining factors to growth (Jacobs, 2012). Timescales are also important, as for a longer term assessment, the need for the growth of the environment sector is much stronger. Within the short term, the cost of implementing policy seems out of proportion to the returns possible in the same time frame. However, over a longer period, advances in the market and innovation means growth within the environment sector can increase exponentially (Hallegatte et al., 2012). Secondly, ensuring the protection of the environment now, will require less finance than addressing the situation further into the future (Flannery, 2009; Ward, 2010). Thus, investment in green growth is required now, to ensure that damage to the environment via long term investments in high carbon measures, which lock in damaging practices, are not made (Unruh, 2000). Investments of these types cause long term high emissions and fossil fuel depletion. In looking at creating effective action now, policymakers may need to look beyond the short political timeframes and cycles which operate within the UK. Policy needs to both contain an urgency to create change now, but also look at long term forecasts and at what changes are needed to be effective into the future.

These previous points do not go as far to say that green growth should become the widespread way in which all commerce is conducted. However there are the following points to take into account, suggesting that focusing policy to promote the marriage of environmental protection and economic development, such as the promotion of activity within the EERS sector, may be an effective overall discourse.

Firstly, climate change has started to impact upon the water and food supplies globally; causing price fluctuation and insecurity, the concept of carbon intensive growth has become more and more unattractive to governments (Haas, 2012). The second point is that with a greater emphasis on green growth via policy, the impact upon more general growth effects will be larger, in particularly due to employment and innovation (World Bank 2012b). Thirdly, in coupling environmental protection and economic prosperity under a policymaking umbrella, green growth has the ability to gain support from a wider array of actors than sustainable development which had limited focus and lacked definite aims (OECD, 2011).

There is opposition however from groups such as net benefiters from carbon intensive industries, and also from groups who see green growth as simply a mask for environmentally destructive capitalism to hide beneath (Hoffman, 2011). Plus there are environmentalists who see any continuing growth jeopardising the way in which the earth can support the global population (Jackson, 2009). Even with this opposition, the fact remains that carbon intensive societal components such as inefficient power stations and the housing stock, need to be dealt with sooner rather than later. This urgency can only be addressed with a coupling of efforts from policymakers and private businesses (Hallegatte et al., 2012). Therefore, in the case of correcting the carbon intensive infrastructure and fabric makeup of our UK society, green growth via policy intervention is a method of reducing carbon emissions at an accelerated rate, whilst also providing social and economic returns to a nation in recession.

This section has detailed the need for policy to intervene with business to induce heightened action to save carbon. The case of the EERS sector is an exemplar, as with the correct policy landscape large carbon savings can be coupled with a large volume of UK wide employment opportunities and economic benefits. The following sections will therefore look into recent EERS sector related policies, along with lessons which can be learnt from the UK and German policy contexts, two exemplar nations selected from within the EU.

2.5 Retrofit Policy

A significant driver of UK policies designed for retrofit is the 2008 Climate Change Act, which set targets for GHG reduction of 80% from all sources by 2050, when related to 1990 levels (Committee on Climate Change, 2011). Furthermore, a reduction of over 65% of domestic property emissions from 2011 levels was called for by 2022 (Committee on Climate Change, 2011). Therefore, the EERS sector needs to adopt an effective working strategy alongside policy makers to enable this reduction to become reality.

2.5.1 Historic retrofit policies

As a strategy to create a route to achieve these climate change targets the UK government introduced different schemes to increase the standard of energy efficiency within the housing stock (DCLG, 2013). These include policies such as Warm Front; the Carbon Emissions Reduction Target (CERT); and the Community Energy Saving Programme (CESP). The most recent policy however to impact the EERS sector is that of the GD.

These policies have been selected to provide an indication as to the extent to which the policy discourse concerning the EERS sector has altered over recent years. In particular the factor that subsidisation levels have dropped substantially from schemes such as Warm Front, CERT and CESP, in comparison to the GD. This highlights the changing way in which policy interacts within the EERS sector, and the different levels of expectation of supply chain practitioners.

Within the published material related to this research, the journal paper titled *Energy efficiency retrofitting services supply chain; a review of evolving demands from housing policy (Energy Strategy Reviews, 11, 29-40),* produced the following key output highlighting the ability of the GD and its predecessor policies in removing barriers to retrofit activity increases. This output used existing literature and actual policy documents for the GD, CERT, CESP and ECO is evaluate whether the schemes tackled barriers to retrofit, made provision to tackle barriers but failed, or made no provision at all. Figure 1 provides an overview of the findings.

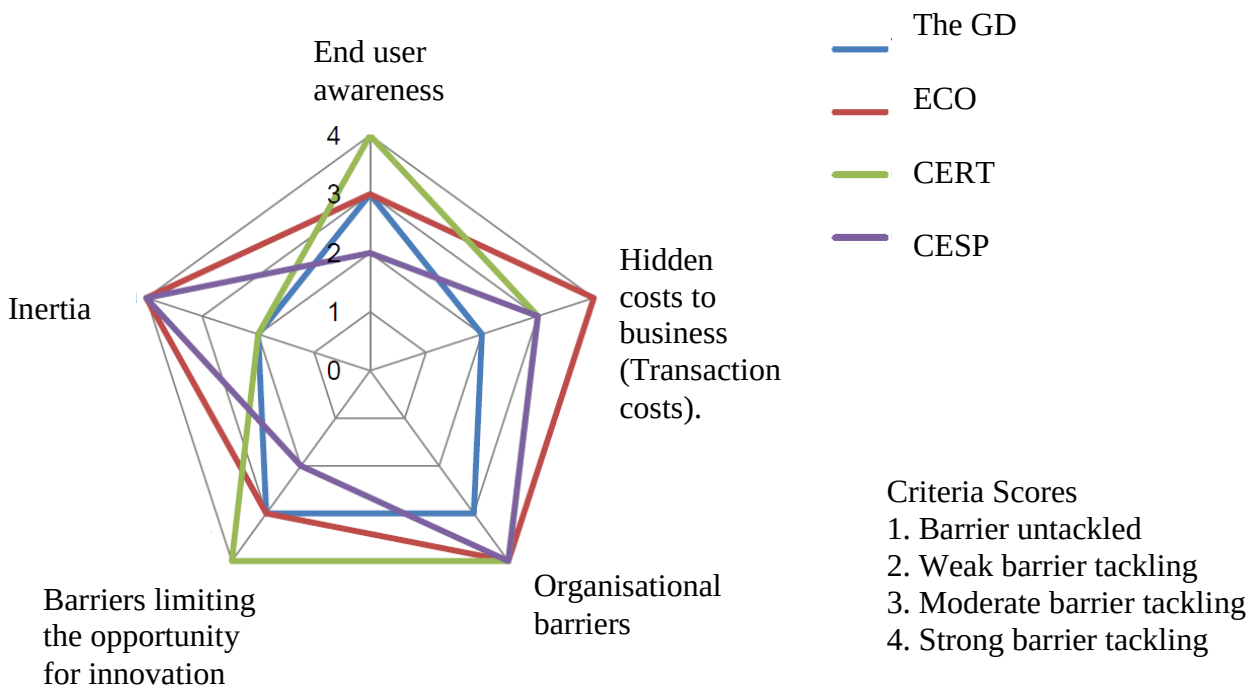

Figure 1: Review of past policy ability to tackle barriers to retrofit growth.

This figure (1) shows that overall policies have attempted to tackle certain barriers to retrofit in more focused ways than others. Further details of the findings of this policy review can be located in Gooding and Gul (2016).

Carbon Emissions Reduction Target (CERT)

-CERT was active from 2008-2012, CERT obligated energy suppliers to reduce customer carbon emissions (Dowson et al., 2012). These emission savings had to comprise of 60% via insulation measures and the remaining 40% of carbon savings needed to focus on priority groups, such as low income or elderly homes (OFGEM, 2011). CERT development grew from a technical base, emphasizing the take up of carbon saving measures. This produced a policy which was focused and achievable, with a high degree of stakeholder consultation, particularly with suppliers (DECC, 2011a). The length of time CERT was operational for also created a supportive environment for stakeholder engagement and administration. The extended duration CERT was operational for meant that all participants grew to know what is required at the varying project stages (DECC, 2011a).

Community Energy Savings Programme (CESP)

CESP was a scheme funded via energy company obligations, aimed at providing funding to community groups, housing associations and local authorities to improve the energy efficiency of hard-to-treat properties (Energy Retail Association, 2011). The policy emphasised whole house approach, treating properties in a street-by-street approach (EEPH, 2008). Between the operational periods of 2009 to 2012, the scheme financed almost 100 community initiatives, resulting in the retrofitting of 90,000 properties. 81% of these properties involved solid wall insulation, and 65% boiler replacements (DECC, 2011a). The CESP delivery model focused on creating partnerships and schemes which were locally specific, offering a method of increasing the rate of localised energy savings particularly within deprived areas. This local emphasis meant that the delivery model focused primarily on the economies of scale which could be generated on large social housing estates for instance (Energy Retail Association, 2011).

Warm Front

Warm Front was a publically financed scheme offering heating and insulation funding to homeowners and private renters, living in a property where the SAP rating was less than 55 (band D). To qualify, recipients had to be receiving income support, state pension or Job Seekers Allowance. Up to £3500 was available to provide loft insulation, cavity wall insulation, draught proofing measures and new heating systems. The National Audit Office (2009), stated that since the scheme's inception in 2000, over 2 million properties had been treated, resulting in a cost of £2.2 billion. Over 75% of beneficiaries stated themselves satisfied within the scheme, even though there were concerns that the first come first served basis of the scheme, meant 75% of recipients were not affected by fuel poverty.

Energy Company Obligation (ECO)

The Energy Company Obligation (ECO) operated alongside the GD in aiming to tackle carbon saving and fuel poverty simultaneously. ECO fitted in with the GD by offering measures that do not meet the Golden Rule assessment; positioning ECO to deliver measures which were less cost effective (Rosenow and Eyre, 2012). ECO's design is structured to provide high cost measures to low income households, or those in fuel poverty (Guertler, 2012). The two policies were linked via the method of delivery as the private businesses providing the services had the potential to be the same organisations, with the ability to

bundle additional measures on top of an ECO funded package and process this addition as GD energy efficiency improvements. Providers gained 'jobs' by bidding on brokerage auctions fortnightly to win 'lots' of ECO retrofit projects, sold by the energy companies (Murphy, 2012). The initial ECO model was unprecedented within UK policy design, and therefore contained some initial issues. Firstly, as the scheme prioritised hard to treat properties with solid wall insulation, and cavity wall measures, there was a knock on effect in the relative restrictions in other areas of the market (Eyre et al., 2009). Secondly, in focusing on high cost measures, which inherently require greater obligation funding, ECO applied a lot of pressure on businesses supplying solid wall insulation and cavity wall insulation to grow in capacity at a fast pace (Aire, 2012). Thirdly, research indicated that the proposed impact of ECO was too limited. By 2023, ECO was anticipated to remove 125,000-150,000 households from fuel poverty, a number which was 20 to 40 times too small to tackle the problem, meaning that ECO could have actually been in place while there was a 29% increase in fuel poverty (ACE, 2012).

These policy schemes due to their different designs, involved the allocation of varying amounts of financial input, amounts which are important to consider when discussing policy impact. The above overview of the policies shows that due to the obligatory nature of ECO and CERT, and the fact that they operated at such a large scale, CO_2 savings per year were much higher in comparison to CESP, which operated on a smaller scale, and the GD, which did not have an obligatory aspect. The overview also shows that both CERT and CESP achieved the most cost effective ways in which to save carbon, in comparison to ECO, which placed a high requirement on energy companies to retrofit more vulnerable households, which required increased resources per retrofit, and the GD, which required increased finance to recruit loan applicants. These increases in requirements of scheme administration cause ECO to cost £61 per tonne CO_2 saved and £150 per tonne CO_2 saved for the GD.

The stance government took to deliver the above policies was one of funding measures via government financial incentives. Schemes have been traditionally administrated by the state and have taken a social welfare stance. This produced significant increases in the standard of properties, particularly those occupied by the socially deprived. Post 2010, Coalition Government election aims remained the same, however delivery mechanisms changed. In the lead up to the General Election in 2010, the three main political parties (Conservatives, Labour, and Liberal Democrats) set out their domestic energy efficiency improvement

manifestos. The consensus across the manifestos was to bring in a pay-as-you-save (PAYS) mechanism to increase the rate of energy efficiency improvements, yet at the same time reduce the level of public spending. These schemes provide homeowners with upfront finance to invest in energy efficiency measures, which are then repaid via energy bills. Upon winning the election and establishing a coalition with the Liberal Democrats, the chosen Conservative scheme, the GD, was introduced. March 2010 saw the release of the conservative publication; *Rebuilding Security Conservative Energy Policy for an Uncertain World*. This paper indicated how the GD would work, with the participation of a variety of financing groups, such as high street banks and retailers, investment funders, local authorities, community associations, social enterprises, housing associations and energy suppliers (The Conservative Party, 2010). Encouraging private financing in this way, aimed at lessening the pressure on public funds, and the artificial market conditions created by subsidy, as with previous schemes. Furthermore, focusing on the private sector permits the creation of a profitable and economically sustainable industry, which could aid employment (Rosenow et al., 2013). It was envisaged that the capital intended to be provided by the private sector could mobilise new business areas for GD providers, assessors and financiers. This post 2010 Government strategy for carbon and fuel poverty reduction is not dissimilar to the Labour approach adopted previously, because the PAYS format what initially founded within the Labour party (UKGBC, 2013). However, unlike Labour's government funded PAYS scheme, the GD was driven by what are effectively private loans.

2.5.2 The Green Deal

- Operational from late 2012/early 2013 to July 2015, the GD permitted bill payers to retrofit their properties with energy saving measures, without the need for any upfront payments (DECC, 2011b; DECC, 2015; Rosenow and Eyre, 2012), as loans were secured against the property.

- Repayments for the retrofit upgrades were generated via on bill payments post installation (Rosenow and Eyre, 2012).

-The GD relied upon 'the Golden Rule' to ensure that the value of any energy saving generated by the improvements, was no less than the repayments for the measures (Guertler, 2012).

-The delivery, management and financing of the GD were placed in the hands of the private sector. A consortium made up of banks, businesses, local authorities and investors took on the responsibility of finance provision (Dowson et al., 2012). Plus, during the early stages of the policy, the Government offered cash back incentives to early adopters, by way of accelerating initial demand (DECC, 2011b).

The GD operated by first having a property assessment carried out by an accredited GD assessor, to establish the level of existing energy efficiency, and then to suggest tailored improvements to increase the energy efficiency level of that particular property. This assessment was to provide a formal GD assessment and EPC. The formal assessment could then be presented by the property owner or tenant to a GD provider for a financial estimate for the measures and their installation. Alongside this estimate was a GD plan which stated the terms of the loan repayments, which would be collected by the property's energy supplier. To ensure improvements were carried out to a high level of quality, all GD accredited businesses had to adhere to a framework of practice regulations, permitting companies to use a GD quality mark (DECC, 2010a).

Unlike traditional loans, the repayments for the GD financed retrofit measures were attached to the property, not the bill payer. This incentive meant homeowners and tenants could save energy without the need to take on personal debt (Richards, 2013). The GD therefore focused on providing a carrot to removing any financial barrier to retrofitting.

The GD is a central policy under consideration here; as it placed the responsibility of implementation and pushing the policy forward squarely at the door of the EERS sector (DECC, 2010a), and therefore this interaction and subsequent impacts forms the basis the research here. Plus, unlike earlier policies which targeted low income homes in the main, the GD was designed to encourage retrofit action across the whole UK property stock, thereby further emphasising the need to assess GD/EERS sector interaction to determine methods of learning for the policy.

As this research is assessing the capabilities of the EERS sector in relation to the GD and its ability to encourage capacity building and demand increases, the evaluation of the GD will focus on the following two areas:

- Inherent barriers to uptake.

- The policy's impact on the EERS within the UK.

2.5.3 Green Deal Barriers

The GD positioned itself to solve the three sided energy dilemma (addressing environmental degradation, energy security, and energy prices) (Dowson et al., 2012). The GD therefore prioritised private involvement in delivery of residential energy efficiency, minimising government funding and therefore promoting market confidence, prosperity and employment (While, 2013).

The Green Deal was intended to have a high level of impact, via the provision of 14 million property retrofit schemes by 2020 (DECC, 2011). However, in practice the policy significantly failed in achieving any notable result level. In actuality approximately 6000 properties per year received a scheme of retrofit works under the Green Deal, meaning about 14,000 properties were retrofitted during the policy's operation period (January 13-March 16) (DECC, 2016). Plus, in comparison to predecessor policies, the Green Deal resulted in substantially lower carbon savings. Per year, the predecessor policies of the Carbon Emissions Reduction Target (CERT) and the Community Energy Savings Programme (CESP) delivered approximately 68 $MtCO_2$ in savings over the lifetime of measures (DECC, 2009; DECC, 2010a), compared to the GD's 0.4 $MtCO_2$ of savings (NAO, 2016; Rosenow and Eyre, 2016).

Table 4: Potential factors causing GD failings in uptake.

Finance	Inconclusive evidence to suggest that the removal of the barrier of lack of finance would provide sufficient incentives for large scale uptake.
Government	Lack of public finance to aid the appeal of the financing mechanisms of the policy, limited the ability for large scale interest and uptake in the policy. Lack of public finance to aid policy promotion also limited overall impact.
Occupants	In focusing on the property, the ability to increase the level of carbon savings from properties via educating occupants could have been missed.

Firstly, the method of placing the loan on the building and not the homeowner or tenant is an innovative method to generate retrofit at scale, meaning the implications of the scheme were unknown (table 4) (Dowson et al, 2012; Rosenow et al., 2013). The background theory supporting the design of the GD was that the financial barrier was the main halting force to energy efficiency investment. The issue with focusing on purely the financial barriers to retrofitting is that numerous research studies have identified other barriers which could also be at work (Brown, 2001; Eyre, 1997; Jaffe and Stavins, 1994; Sanstad and Howarth, 1994). Other issues could take precedence, such as building disruption, lack of knowledge and lack of advice (Rosenow and Eyre, 2012). From this stance therefore, it can be seen that the capability of the GD removing all the barriers to energy efficiency uptake was unlikely. What is more, the carrot that was provided via the scheme (financing of measures), did not completely remove the financial barrier to energy efficiency upgrades. There was concern that due to limited government support for the scheme (table 4), the interest rates were not made very attractive to potential clients (While, 2013). This high loan price was exacerbated by the fact that private businesses were reluctant to lend money without the government underwriting the loan. This reluctance is due to retrofit measure lending being considered high risk, due to its embryonic nature (Dowson et al, 2012).

The lack of GD loan appeal was also potentially due to the perceived negative effect on property sales. Prospective property buyers of GD improved buildings were thought to in theory request a price discount on a freehold property if there were outstanding GD loan repayments. From this perspective, taking out a loan would not provide consumers with a guaranteed method of increasing the value of their property. In addition, the policy stated that valuations of GD retrofitted measures had to be capped at their market value, further reducing incentives for individuals wishing to take out credit to increase the value of their property assets (Arie, 2012).

In solely focusing on fabric improvements the GD could have missed an opportunity to address the factor of behaviour in energy consumption (table 4) (Dowson et al, 2012). It is estimated for instance, that energy take-back or the rebound effect could occur post retrofit. This could detract 20-30% of the energy savings predicted by the Standard Assessment Procedure (SAP) assessment pre-retrofit (Greening et al., 2000). It is stated that inefficient properties are in the main, under-heated to provide savings to the occupants (Stockton and Campbell, 2011), therefore retrofitting a property provides the tenants or homeowners with

an attitude to take-back the energy they have previously stopped themselves from using, due to financial restraints (Sorrell, 2007). This effect means GD loans supplied may have been inaccurate and predicted unachievable savings. Without a targeting of behaviour or energy pricing therefore the GD may have missed the opportunity for significant energy use reductions (Arie, 2012). Additionally, in not targeting the price signals from the energy market, the policy also did little to address the factor that the highest energy usage houses are owner occupied and have a large income (Brounen et al., 2012). Without providing means to target the 20% minority of high consumption wealthy households which use approaching 50% of all domestic energy (Druckman and Jackson, 2008), the overall impact of the policy was limited.

The GD utilised accreditations to ensure energy assessors and installers provided a quality service. This went some way to remove the barriers previously mentioned of inaccurate information and the lack of credibility and trust (Pearson, 2011). However, the presence of accreditation schemes for EERS sector practitioners had the potential to only be known by members of the public with an interest in retrofitting. Implementing legislation for the supply chain to comply with would not attract uninterested parties. This meant that to an extent the policy was not tackling the marketing of energy efficiency retrofitting to increase demand (Rosenow and Eyre, 2012).

2.5.4 The impact of the GD on the UK EERS sector

Due to the fact the GD was financed, managed and delivered by the private sector, the development and integration of the supply chain was paramount (Koh et al., 2012). To reach the UK's carbon reduction targets, 12,000 properties were needed to be retrofitted per week from 2014 (Lowery, 2012). Past statistics of the growth of the cavity wall insulation (CWI) industry (which was a key component of the GD supply chain) suggested that this was out of reach in the short term. In 1994, 100,000 CWI installations were carried out, with policy pushing the industry, installations grew to 550,000 in 2005 (OFGEM, 2010). This growth in scale was positive for the GD, reaching 12,000 properties per week proved to be beyond reach. The estimations within the GD's impact assessment also placed the EERS sector in a difficult position, as the expectation was for a very significant growth in capacity, within a short period. The assessment stated that solid wall insulation measures should increase from around 45,000 (2013), to 125,000 per year to achieve 1,000,000 by 2022 (DECC, 2012b).

Private financing of the GD also produced some problems with effective delivery. The GD loan repayment was attached to a property's electricity bill, a bill which could be defaulted by homeowners or tenants (Arie, 2012). Therefore, the risk to the GD provider who signs the credit agreement with the property occupant or owner was high. Although there were provisions to vet individuals to assess their financial position, there was a risk the loan would not be repaid (Sullivan et al., 2012).

2.5.5 The role of the EERS sector post Green Deal

As can be appreciated by the detailing of the GD and it design and failings, the EERS sector was required to advance its capabilities significantly, and at a rapid rate. Although not the entire reason as to why the GD did not achieve the sort of results as it was predicted, the lack of sector progression to deliver the policy can be stated as a contributor. To enable learning to occur post policy, it is considered valuable here to not only examine the impacts of the GD upon the EERS sector but to also compare the policy to another nation (Rose, 2004). This nation is chosen as a country which has a higher performing track record of policy aiding the supply chain to produce higher levels of retrofit.

2.6 Comparing the UK's policy landscape with Germany's

In comparing the UK energy efficiency policy landscape with another nation, the assessment is permitted to assess how relative yet distinct policies are formed and also perform. Comparing instruments utilised in different countries offers a means to produce ideas as to how an instrument or set of methods could work most successfully in producing conditions for optimal retrofit levels (Swan and Brown, 2012). Furthermore, in selecting front runner nations, it is considered that an abundant evidence foundation can be used, a base consisting of both regulatory mechanisms and also policy schemes (Janicke, 2005). This theory led to the decision to select Germany as a country to compare with the United Kingdom in strategy.

Germany is chosen as a comparison country for the UK, for the following reasons:

- Both the UK and German policy case studies are considered exemplar forerunners within the international arena (Murphy et al. 2012).

- The UK and Germany are similar in the carbon output of their respective built environments. 30% of UK carbon is emitted from residential properties (DECC, 2010b), whilst in Germany the figure is 33% (BMU, 2010).

- Both case studies have had their respective energy efficiency policies described as innovative and ambitious (IEA, 2009). Furthermore, the German CO_2 Building Rehabilitation Programme (CBRP) has been described as a blueprint for how energy efficient improvement financing should be carried out (UNEP, 2011).

- A moderate climate in both countries means thermal envelope requirements are similar.

- The level of retrofit required is similar in that in both the UK and Germany 50-70% of properties were built prior to 1970 (Itard and Meijer, 2010).

2.7 The German Policy Landscape

Post Word War 2, policy focus was directed at economic recovery within Germany, as with the rest of the European community. However, with an increasing role of the chemicals industry in national recovery (Jones and Lubinski, 2013), and the rising number of environmental accidents and pollution incidents, a new public consciousness for the protection of the environment was swelling. With growing public concern for the protection of natural spaces and the eradication of high pollution industry, especially adjacent to residential areas, the outdated Prussian Industrial Code, which heavily pushed in favour of economic development above environmental protection, was modified (Jones and Lubinski, 2013). This growing public awareness meant that by 1970, 44% of German residents stated that they would be willing to make personal sacrifices to aid environmental protection. With burgeoning public support a raft of environment protection policies first came into force during the 1970's, including the Water Disposal Act (1972), the Federal Control of Pollution Act (1974), and the Federal Nature Conservation Act (1976). These national policies have enabled for around 30 years since, the formation of a key component within local policy frameworks.

Policies to increase the energy efficiency of residential properties have been expanded and strengthened four times, since 1971. This policy tightening means that a new property built today would use 25% of the energy a similar property built in 1977 would consume.

Furthermore, it also means that an extensively retrofitted property improved today would have to achieve a 60% improvement in terms of consumption when compared to 1977 properties. This shows that German policymakers have had to undergo a policy learning process to ensure that an effective universal standard has been created for all properties.

This learning process has resulted in regulatory, incentivising and information providing policies, combined to produce the highest likelihood of bringing Germany in line within the European Union (EU) aim of providing an 80% reduction in energy demand by 2050, from 1990 levels (Tiefensee, 2006).

2.7.1 The provision of upfront capital and support; the KfW

The KfW bank (Kreditanstalt für Wiederaufbau Bankengruppe) was formed in 1948 as part of the Marshall Plan to encourage post war economic growth and is a public credit organisation which provides finance for domestic refurbishment (Schroder et al., 2011). The first specific KfW schemes aimed at housing refurbishment commenced in 1990, with a focus on housing modernization. In 1996, the first carbon reduction scheme was initialized, in the form of the *$C0_2$-Minderungsprogramm* (CO_2 -Minimization Programme) (Schroder et al. 2011). These schemes then were superseded by the CBRP in 2001, which contains two components; the *Energieeffizient Sanieren* (energy efficient retrofit) and *Energieeffizient Bauen* (energy efficient construction). The CO_2-Building Rehabilitation Programme (CBRP) is government funded and enables the KfW bank to provide loans for retrofit and construction at preferential rates. Prior to 2011 the scheme was 100% funded via public means, post 2011, the Energy and Climate fund was established, meaning funding from energy supply channels could be operationalized. This funding came from obligated energy suppliers, and was aimed at supporting energy technology development, electric vehicles, as well as energy efficiency measures.

Under the *Energieeffizient Sanieren,* finance is available via loans and grants to fund all measures from single components to deep retrofits. Loan repayment terms become more favourable when properties are improved to a higher level (Amecke et al., 2011).

For energy efficiency retrofit activities, the KfW *Efficiency House Standards* set out five promotional levels, with Efficiency House 55 as the most stringent (the remaining four standards are Efficiency House 70, 85, 100 and 115) (Schimschar et al., 2011). These

different standards equate to the percentage of primary energy consumed post retrofit, 100% being the reference figure stated under the Energy Efficiency Ordinance (Neuhoff et al., 2011). The incentive to maximise household carbon reductions is via more favourable retrofit loan repayments and interest stipulations, depending on the level of carbon saved (Amecke et al., 2011). Due to the scale at which loans are provided and due to the government financing and underwriting the loans, the financial repayment terms are in the majority of cases more favourable than traditional commercial loans (Rezessy and Bertoldi, 2010). This therefore provides a successful method of overcoming the financial barriers to energy efficiency retrofitting. The CBRP is a world leader in generating retrofit at scale, with numerous studies establishing that the programme has a high impact (Sunikka-Blank and Galvin, 2012; Murphy, 2012). From the perspective of the German EERS sector therefore the CBRP provides a method of generating high levels of ongoing business. This sustainability of demand reduces the risk to investors when increasing business capacity or launching a new business operation. More widely the CBRP also acts as a key driver in stimulating the supply chain, aiding the creation of a German low carbon economy. One third of the research and development financing has origins within government (Kiss et al., 2012), with the total research and development (R&D) public funding amounting in 2009 to 22.5 million Euro (IEA, 2009).

The KfW also provides incentives to landlords to retrofit tenanted properties with energy efficiency measures (Schröder et al., 2011). This aims at tackling the split incentive; the concept that landlords will be aiming to minimize the investment in a property, while the tenant will desire a property which has had significant energy efficiency investment (Gillingham et al., 2012). The KfW loan scheme tackles this ‘landlord-tenant problem’ by providing repayment bonuses and tax incentives to landlords, compensating for rent losses and disruption (Murphy et al., 2012). This factor is an advantage to the EERS sector in the fact that it provides an additional market sector to derive income and business.

The success of the CBRP in relation to other EU schemes is well documented, with Germany generally considered a forerunner in the domestic energy efficiency policy arena. Indeed the policy landscape creates an environment whereby KfW incentives push retrofitting beyond standard building regulations (Murphy et al., 2012). Moreover, the incentives offered by the KfW provide a suitable balance between obligating and incentivising, these incentives also harbour security for the EERS sector and customers, as they are guaranteed until the end of

2014. However, post 2014 financial assistance may change, as was the case in 2010, when funding decreased (Rosenow, 2011).

The KfW financial schemes are however not without their issues, firstly there is the factor that low income households in fuel poverty are not widely acknowledged within Germany, meaning there is inconclusive evidence as to whether the KfW funding mechanisms are assisting those in most need (Rosenow, 2011). This issue is exacerbated by the fact that KfW assessment procedures focus on the energy saving potential of the property and not the financial status of the occupant.

Höhne et al., (2009) state that for the advancement of energy efficient building within Germany, significant regulation of projects is needed to navigate the complex legal framework. This complexity is also inherent within the different federal, regional and local level support programmes (Kwapich, 2010). These differences in scale of authorities provide difficulty in the fact that historic building conservation is the responsibility of regional authorities, while the concept of historic protection is the role of municipalities, meaning the application of energy efficiency measures can come up against different viewpoints and red tape (Weiss et al., 2012).

The actual uptake rate and the influence of retrofit at scale is also not as successful as perhaps has been reported (Hamilton, 2010). Diefenbach et al., (2010) found that the rate of refurbishment within existing housing was in fact rather low. In a study of 7500 households, the annual retrofit rate for facades was 0.8% and 1.3% for roof insulation between 2005 and 2008. If these rates are representative, the German carbon reduction targets are ambitious (Murphy et al., 2012).

Within both the UK and German policy landscapes there are provisions for renewables and low carbon energy production methods. Schemes promoting these technologies run alongside the energy efficiency policy stated above. The scope of this research is such that these policies have been positioned aside from the retrofitting policies. The main reasoning for this is that in general the delivery of retrofit measures requires an entirely different set of stakeholder. Energy efficiency improvements within residential properties are labour intensive, multi stakeholder, geographically dispersed processes, entirely different from the renewable energy general supply chains which operate within specific geographies and have a less extensive supply chain and labour force. These differences have meant that in this

research the scope to effectively look into comparing the different renewable policies would be overextended.

The German method of addressing EERS sector expansion differs in a number of ways when compared to the UK policy context. Both countries have adopted pioneering methods of achieving large scale carbon savings. These methods are complex and involve the roles of a large number of industry actors and a high frequency of financial and knowledge transactions. In light of these factors, the following section will discuss how the theory behind this research has been selected to investigate the EERS sector in the greatest possible depth.

2.8 Literature review conclusions

It is considered that the literature reviewed here details that there has been significant research completed which investigates; implementation chain, policies aimed at increasing retrofit, the issue of the energy efficiency gap and the need for increased retrofit delivery expertise. What is considered absent however is that due to the recent changes in policy strategy within the UK, the impacts of a private supply chain centric scheme have not been assessed in detail. This suggests that research into the impact of the GD on the EERS sector and policy learning from this interaction would make a contribution, which would be both novel and timely due to the fact that a replacement policy mechanism has not yet been implemented. This lack of progress post GD therefore highlights the need to learn from the policy, take a positive stance and view it as a lesson to be learned, and apply this learning to the design of a new policy strategy. This learning also needs to be configured to enable increased understanding of the numerous barriers to retrofit, barriers which need to be addressed and prioritised if end users and EERS sector businesses are going to come together more readily to complete projects. Therefore, in the case of this research, the outcomes of the policy mechanisms assessed, are in relation to the development of innovation and technology, market evolution, the advancement of networks and actors, learning and training aspects and the minimisation of TCs (Kiss, 2013). The next chapter describes the research approach adopted.

Chapter 3. Research Approach

Having established the knowledge gap in the previous chapter, this section details the overall framework this research utilises, which characterises theory relevant to the EERS sector and related processes. Or in other words, an initial model of what is presently existing, what it is that is planned to study, and what is occurring with these concepts and why (Maxwell, 2008). From this, applying an analytical framework can assist in structuring the research plan, and also the procedure of working with collected data (Smyth, 2004). Therefore, the purpose of utilising the analytical framework whist carrying out data collection and analysis generates the potential for the framework to guide the research, to successfully address the research questions. This application of the analytical framework therefore has a significant impact on the strategy of methods to be employed here.

Consequently this section performs the role of bridging the gap between the literature review and methodology sections. Within the literature review, details of the EERS sector within the UK and Germany is presented along with the policy drivers present in the two nations. From this background, it can be acknowledged that an increase in information regarding the optimal formation of the EERS sector, and also the policies at work is required.

Policy in its broadest definition is a set of decisions which are followed by a package of actions or values (Hill, 1997). These decisions, actions and values are, in the main, then adopted by a network of both public and private stakeholders. In the case of this research, policy is defined as interventions originating from government, which operate via different mechanisms such as organisational or financial schemes, to focus on achieving aims from a specific political agenda (Fischer, 1995). Energy efficiency policy in particular, as a subsector of energy policy, forms a connecting influence between a variety of areas, including; technology, sociology, economic and politics (Levine et al., 1995). Traditionally, energy policy has had technology at its heart, with key actions aimed at addressing energy supply from both sides: distribution and consumption (Johansson and Goldemberg, 2002). Here, energy efficiency policy will be defined as a set of principle laden actions carried out by stakeholders, with the aim of increasing energy efficiency within properties and also expanding the related economic, environmental and social benefits (Mundaca, 2008).

Policy is realised in practice via policy instruments (Fischer, 1995), which are defined as tools for stakeholders to support change via modification of process or behaviour to achieve

policy aims (Carter, 2001). These instruments in the main perform collectively as sections of a portfolio. In the case of this research, policy mechanisms for energy efficiency improvements are defined as:

'*methods utilised by actors within private and public spheres aimed at implementing policy via behaviour and process alteration* (Kiss, 2013).'

In attempting to assess the relative performance successes of policy tools, policy learning via evaluation needs to take place. The process of policy learning has emerged over recent years (Kiss, 2013), and focuses policy appraisal on gauging the impact of policy in terms of energy savings or CO_2 emission reductions (Gillingham et al., 2006). These impacts go alongside the outcomes of policy such as technological advancement, market share increase, knowledge progressions and actor network growth (Kemp, 1997).

Policy learning is a wide-ranging concept which different existing research has defined (e.g. Bennett and Howlett, 1992; Galvin and Sunikka-Blank, 2013; Sanderson, 2002). Policy learning has foundations in different conceptual frameworks, emergent from various disciplines including organisation and political themes, along with innovation and more empirical areas. Overall, the learning within the discipline aims at increasing the level of knowledge regarding the design, implementation and analysis of policy frameworks, generating performance feedback. However, this learning can differ dependent upon the conceptual framework being utilised, with variances occurring in who is learning, about what is being learnt, and the resultant impact of the learning. Consequently, policy learning can be termed a structured alteration in thinking regarding a particular policy aspect (Kemp and Weehuizen, 2005). A policy aspect can be outlined as any action or set of values on which a policy is founded (Bennett and Howlett, 1992). To enable a holistic and rounded consideration of a policy, the learning here can also occur from three viewpoints, including the design of policy, the types of instruments being used, and the overall policy goals (Hall, 1993). From this all-inclusive standpoint, within this research, policy learning is deemed to mean a process which has the potential to restructure policy strategies, ideally for an increase in policy effectiveness.

Policy evaluation is a key strategy to gain increased awareness as to the performance of a specific policy. Policy evaluation, within this research, is defined as the assessment of the

design, value and outputs of a retrofit policy. Outputs which in this case are the incentives designed by governments to enhance the level of finance available to end user for retrofit activity. Subsequently, policy outcomes can be assessed in terms of actual retrofit activity, increase in energy efficiency awareness amongst end users, and also enhancement of the capabilities of the EERS sector.

These points of assessment offer increased understanding of policy relevance to the sector, and thus its legitimacy in design and implementation.

Policy evaluation therefore, is the assessment of the value of a policy landscape in achieving outputs; changes induced via policy within the system. Policy evaluation aims at increasing the level of understanding of policy mechanisms and their application and legitimacy to a particular situation, focusing in on both outputs and outcomes (Mundaca, 2008).
Policy here is therefore appraised in relation to five outcome parameters (detailed further in figure 2):

1. The *diffusion of energy efficiency products and solutions throughout the sector, permitting changes in sales volumes, market activity and also economies of scale.*
2. *The process of products and innovation to optimise the activity of increased domestic energy efficiency.*
3. *The change in formation of actor linkages to increase the rate and scale of retrofit activity.*
4. *The processes which lead to change within the EERS sector, and can be seen via the innovation and related evolution of a policy landscape.*
5. *The ways in which policy can lessen the negative impact of high setup and administration costs of complete an energy efficient retrofit project.*

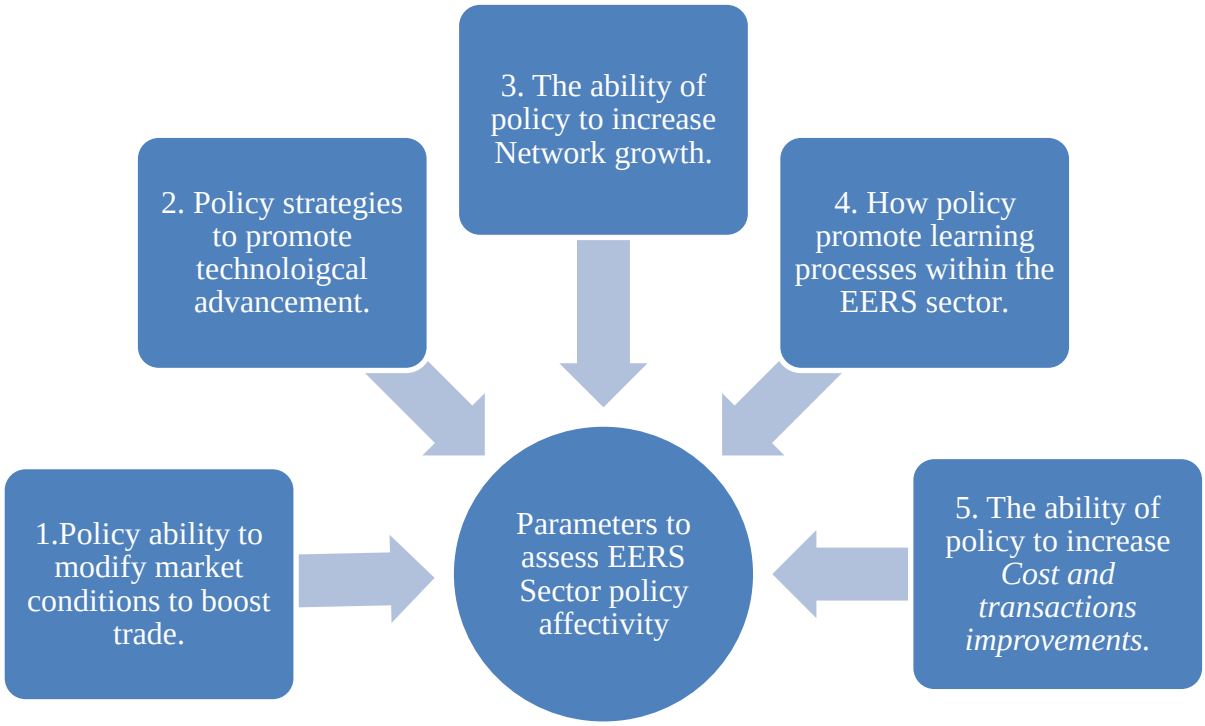

Figure 2: Parameters to evaluate EERS sector policies

From these five evaluative themes (figure 2), two theories will be taken when assessing policies. Firstly, policy successes will be assessed in their ability to minimise transaction or hidden costs influences upon businesses attempting to trade and grow within the EERS sector. Secondly, stakeholder theory will be utilised as an overarching mind-set to assess how the market itself is learning from policy and how the implementation networks respond to the policy landscape. Utilising these two existing theoretical frameworks, it is considered that the five areas highlighted above (figure 2) will be addressed adequately to provide a holistic assessment of policy and its exact interactions with the EERS sector.

3.1 Theories for policy evaluation

Since the policy learning taking place here is designed to take into account numerous different concepts (figure 2). Therefore, to ensure a holistic evaluation of policy/EERS sector interaction the following standpoints (transaction cost analysis and stakeholder theory) have

been chosen to inform the enquiry process. These are discussed in detail in the following sections.

3.1.1 Transaction cost analysis

Transaction cost analysis has been identified as an area that has influences upon the EERS sector. First coined by Coase (1937), the concept has been advanced further by the structure of New Institutional Economics (NIE) (Williamson, 1993). The transaction cost analysis framework enables the assessment of activities within the economic arena, for instance how they are structured and carried out, and what effect these economic activities have on projects and involved actors (Commons, 1931).

Transactions are costs which are emplaced within commerce via the *'human devised constraints that shape human interaction'* (North, 1990, pp. 3). These constraints determine the structure of how individuals exchange skills and values within the political, social and economic spheres. Transactions are a unit of analysis for economic study, with transaction cost economics assuming that these transactions are based upon 'bounded rationality,' meaning that they are imperfect with an asymmetry of information. New institutional economics state that business arrangements are selected to adapt in the most effective way to particular transactions (Coase, 1998), therefore, to understand the intricacies and level of bounded rationality of different transactions within the EERS sector, is of importance. In the arena of technology evolution, TCs are regularly stated as unmeasured expenditures which thwart the implementation of new technologies. Furthermore, in the context of this research, TCs are costs arising before implementation, relating to project arrangement, planning, and ongoing monitoring and maintenance (Matthews, 1986). During a retrofit project, TCs could emerge via the need for due diligence, negotiations, certification, ongoing monitoring and maintenance (Mundaca et al., 2013).

In the case of this research, transaction cost economics will be used to provide an insight into the interactions between public and private actors, and the resultant economic performance of businesses and the EERS sector in general. An assessment of how policy impacts transactions costs will occur, focusing on the nature and scale of the TCs, affecting businesses and projects throughout their lifecycle (table 5) (Mundaca et al., 2013). Table 5 provides an overview of existing research covering TCs and the different guises which they can take. This breakdown of TCs offers an indication of the high level of variance in which TCs could inhibit an EERS sector business.

Table 5: Summary of previously identified TCs

Transaction cost	Sample reference source	Findings
Industry accreditation and approval	Hein and Blok, 1995; Mundaca, 2007	TCs here relate to the process of formalizing business.. The process involves the submission of information regarding business formation and operations. In addition the up-skilling and training of key employees to ensure accreditation.
Tender and procurement processes	Bleyl-Androschin et al., 2009; Mundaca and Neij, 2006	Costs related to working with external parties, ensuring tenders can be won and completed with sustainable margins. These costs are intrinsic to the fostering of close operational relationships and accurate pricing of business activities. Once tenders are won, the process of successful procurement involves costs to establish optimised processes.
Information acquirement	Hein and Blok, 1995; Mundaca, 2007; Mundaca and Neij; Sanstad and Howarth; 1994; Stavins, 1995	Information acquisition covers a whole host of pre-trading activities, including the sourcing of information detailing optimal operational business structuring, most cost effective sources of finance, competition already within the market, technology available and regulatory restrictions, amongst other information regarding business setup.
Appraisal and verification of information	Hein & Blok, 1995; Mundaca, 2007; Mundaca & Neij, 2006; Sanstad & Howarth, 1994	Completed after information acquisition, additional time and knowledge costs are required to ensure information gained is completely applicable to the business structure. This may involve consultation fees and further information searching.
Liability risk reduction costs	Mundaca, 2007	Insuring against operation risk when entering a new business arena requires the generation of forecasts to anticipate business and market evolution, along with insurance costs to protect against unexpected events and market or project changes.
Quality assurance costs	Bleyl-Androschin, et al., 2009; Hein & Blok, 1995; Mundaca, 2007; Stavins, 1995	Whether a service or product, guaranteeing against substandard business performance requires the generation and management of checks along the entire process of service or product conception to aftermarket care.
Negotiation with external organisations	Bleyl-Androschin, et al., 2009; Mundaca, 2007; Mundaca & Neij, 2006; Stavins, 1995	These TCs are present throughout the entire business operational timescale, covering discussion with organizations up and down stream, to the negotiation of sales agreements or contractor arrangements.
Project preparation	Bleyl-Androschin, et al., 2009	Processes and costs involved with project inception are numerous, but in essence are present to ensure a project can be completed safely, on time and in a cost effective way.

In using a transaction cost evaluation within this research, policies designed to aid businesses to set up or grow can be assessed. This assessment focuses in on analysing how much the policy removes the negative impact of TCs (table 5). This is of particular importance to the EERS sector, as due to the heterogeneous nature of the projects within the sector, bundling projects and generating economies of scale is difficult (Kiss and Mundaca, 2013). This means that per project, TCs are high and prevent action from EERS sector businesses as profit margins are unsustainable. For that reason, measures provided via policy are needed to generate arenas where project bundling can occur, and also innovation, to improve the technological solutions available to a larger number of different property types. The theory being that with higher margins possible per project, more businesses, which may be larger, will be enticed to offer services within the sector, driving competition and increasing sector development. This development will in turn drive down end user costs, whilst simultaneously offering a more comprehensive service.

A key aspect in need of awareness when implementing Transaction Cost Analysis is ensuring the definition of TCs and the varying forms they can take. Within existing literature TCs have been grouped in different ways, for instance, Ostertag (1999, p. 2) considers TCs as comparable to 'hidden costs' which are the negative costs associated with energy conservation. Whilst Mundaca et al, (2013) consider the wider cost impacts of time and post installation costs related to monitoring and maintenance also key sources of TCs refers to 'time' devoted to determine the most efficient product on the market as an important source of TCs. This is in turn made even more complex by authors such as Skytte et al, (2003) associating all planning costs no matter how far away from an intervention in terms of time as a TC. Therefore, in this research it is considered important to provide clarity regarding the actual areas under assessment and to be considered a hindering factor to energy efficiency development.

Due to the exploratory nature of the research, to develop ideas as to how the EERS sector could work with policy to be increase retrofit activity, it was considered that TCs in their more wide form should be considered as impacting upon the sector. In this sense it would provide a method in which to identify all possible areas which could be affecting retrofit rates, and therefore offer an opportunity to provide solutions from participants as to how to remove these costs or barriers.

3.1.2 Linking in stakeholder theory

In attempting to evaluate policy/EERS sector interactions from different viewpoints, this research adopts a strategy that a singular theory standpoint cannot capture a variety of different views of supply chain organisation (Singh and Power, 2009). Therefore stakeholder theory is selected as a route to assist this research by producing theoretical strategies to identify and assess activities which are related to a variety of stakeholders operating within the EERS sector. Alongside transaction cost analysis which focuses on the barriers to emergent commercial practices the use of stakeholder theory offers a more open system view, which can assess the processes at work, from the overall view of supply chain and its organisation.

As compared to transaction cost analysis, which approaches the EERS sector via attention to a specific part (costs related to new emergent operations and products), stakeholder theory is driven by the understanding that in modern business arenas, it is not simply the business as an individual entity that operates as a singular autonomous body. Instead, the business operates within a supply chain with multiple intertwined forces of interest (Drucker, 1980).

Within the subsequent section details of the theory and its combination with transaction cost analysis in relation to the EERS sector are given.

3.1.3 Stakeholder theory operationalisation

Within existing literature, EERS sector supply chains have not specifically been researched, and it is only during recent years that research has been produced which has reference to the sector (DTI/DEFRA, 2006; DTZ, 2009: Goldman et al., 2010). Trends from within these studies have shown that most businesses operating within the sector are those which are quite small in size and operation, and the projects undertaken are in the main conducted on a private and individual scale. Therefore to date the EERS sector is stated to be fragmented and lacking in coordination.

In light of this theory of why the sector is formed as it is, this research looks to assess and explain the interactions between different entities within the sector and also the way in which they interact; this is where the utilisation of stakeholder theory is important. Stakeholder theory centres on the assessment of organisational management, and the way values and purposes of businesses and groups are produced (Freeman, 1984). Stakeholders are those

classed as individuals who can determine and influence the purpose of an organisation and its direction (Freeman, 1984). Stakeholder theory has been utilised to investigate supply chains to aid the explanation of why they are formed as they are and why the configuration occurs (Matos and Hall, 2007; Ciliberti et al., 2008). This research takes the concept of stakeholder theory in its widest form, to consider parties such as government bodies, customers, employees, trade groups etc, to assess how the EERS sector has taken form.

Stakeholder theory here therefore is based around two different points:

- The traditional focus of business activities is the need to optimise operations to maximise profitability, and working with different stakeholders, including businesses up and down stream, customers, employees and shareholders.
- Businesses need to have a wide perspective of influencing parties, including those of government organisations, trade groups, unions, public communities, future customers and the public in general.

Taking both of these different strands stakeholder theory can adopt a holistic standpoint in assessing a commercial landscape, and has previously been utilised in assessing how supply chains are formed and configured (Sarkis et al., 2010; Wu and Pagell, 2011). This research therefore takes an evaluative route to assess the EERS sector and its formation under an evolving policy landscape, forming a novel use of stakeholder theory. In particular this policy assessment will utilise the theory to focus in on:

- The different ‘power fulcra’ or key stakeholders in optimising the EERS sector to respond to policy effectively (Genovese et al., 2013), and increase network growth and learning (figure 2).
- The different philosophical standpoints needed by businesses for successful commercial positioning to maximise returns from market positioning (figure 2) under different policies (Donaldson and Preston, 1995).
- The importance of the interface between public and private stakeholder in optimising EERS sector supply chains, and, in turn identifying ideal chain formations.

In terms of utilising Stakeholder theory there are also key aspects which need to be considered to ensure that when using the approach all possible pitfalls are understood.

Firstly there is the notion that boundaries need to be drawn around a business or institution within which is where all stakeholders exist. This is a complex task with potentially some room for subjectivity, and therefore to ensure replicability of the research clarity of defining stakeholder is required. Furthermore, to assess the value of using Stakeholder theory, there does need to be a determined notion of was success is, or how one company can be deemed more successful than another. In the case of the EERS sector, this could be success in economic growth, or employment, carbon saving or indeed increased in societal awareness of energy efficiency, either way it is important to understand the different ways in which a business or organisation can be ranked or scored (Argenti, 1993).

3.2 Combined approach

In coupling stakeholder theory and TCs evaluation, the aim here is to provide a detailed and in depth study of how particular residential energy efficiency policies are operating. This two tier approach helps to assess the development of the EERS sector from a purely market and profit based standpoint, and also a people centric stakeholder viewpoint. In gaining insight into both these aspects, preferential policy aspects can be identified which offer the largest benefits to the sector itself and also those working and being served by the market.

3.2.1 Rationale

As the research aims to evaluate the effectiveness of policy upon industry practitioners in increasing EERS sector capacity and demand for services and products, qualitative data is best suited to enable the establishment of business professional experiences. This route focuses on assessing policy and the private sector, and the increasing reliance government strategies have placed upon the supply chain to increase retrofit activity. Furthermore, as stated by Smith and Easterlow (2004), focusing in on the experiences of ‘lay’ people, and individuals on the ‘front line’ of the research phenomena, the different ways in which policy and industry interact can be identified, along with the sector’s interpretations of policy. Taking this standpoint, this research seeks to assess the ways in which policy is received in every day EERS sector practice, pinpointing exactly what challenges are faced and what kind of policy successes there are. In particular, what EERS sector stakeholders are doing in light of policy, whether businesses are being assisted by government intervention, or whether private business innovation and enterprise is driving sector growth.

It is considered here that EERS sector businesses and individuals involved need to overcome the hindering forces of TCs, and this minimisation of these costs as a central way to growth in retrofit, carbon savings and energy efficiency awareness. Plus, in the case of stakeholder theory, this research deliberates how EERS sector operations influence and alter interactions between different stakeholders. This type of analysis offers novel insight into how external influences such as policy changes, alter the stakeholder structure and nature of operation.

Chapter 4. Methodology

This chapter presents the research methodology utilised to assess in rigorous detail the interplay between EERS sector practitioners and policy, via a mixture of qualitative method strategies for data collection and analysis. In section 4.1 Straussian Grounded Theory approach is introduced, which makes up the methodology foundation stones. In Section 4.2 an outline and justification of the scope of the research is explained, followed by the strategy for data collection stages in section 4.3. Within section 4.4 attention is paid to the specific data collection strategies utilised at the different collection stages, and lastly, section 4.5 introduces the methods for the analysis of the qualitative data. During this chapter areas of weakness and strategies to overcome these areas are detailed.

4.1 Strategy for Research

4.1.1 Straussian Grounded Theory Approach

Grounded theory has the aim of forming a framework which can be used as a foundation for explanatory hypotheses to cast light upon trends within data (Holton, 2007). Analysis structured by grounded theory is focused on conceptualisation of themes, as opposed to the interpretation or pure accounting of data. The effect of this is that it doesn't offer the thick description more traditionally associated with qualitative research; instead the contribution is to produce concepts and more concise explanations of processes within the research environment (Glaser, 2002).

From this it can be specified that adopting a grounded theory stance provides a useful way in which to learn about the opinions, perceptions and outlooks of a participant regarding a specific subject matter. As stated by grounded theory's initial authors Strauss and Corbin:

"If someone wanted to know whether one drug is more effective than another, then a double blind clinical trial would be more appropriate than grounded theory study. However, if someone wanted to know what it was like to be a participant in a drug study [..], then he or she might sensibly engage in a grounded theory project or some other type of qualitative study." (Strauss and Corbin, 1998, p. 40).

Therefore, although quantitative data collection methods may be valuable in calculating viewpoints for a large significant sample, grounded theory methodology can instead provide a suitable framework for systematically learning from respondents.

Furthermore, grounded theory also provides a focus on:
• Experiences which occur in everyday life
• Participants' perspectives
• Enquiry between the researcher and participant as an interactive process
• People's words and personal descriptions
(Marshall and Rossman, 2014)

Grounded theory acted as a response to a relative domination by quantitative research, and advocated the creation of theories and methods of working to link different concepts. From this, instead of providing statistically generalisable themes, the strategy aims at explaining phenomena and providing some prediction regarding possible future trends. In addition to Glaser and Strauss, the work of Charmaz (2000, 2005, 2006) and Clarke (2005) form central pillars to the constructivist viewpoint of grounded theory. Glaser and Strauss initially pioneered the grounded theory strategy of research, but disagreed later in their works on exactly how the approach should evolve. Glaser (1992) stated that the classic strategy was correct, in that 'the researcher should not bring any a priori knowledge to the research endeavour' (p.242). Whereas Strauss, alongside Corbin (1990) stated that researchers should 'allow for the potential of prior theory, nontechnical literature, and personal as well as professional experiences to help researchers gain insight into the data' (Glaser, 1992, p.242). Therefore from this standpoint, within Straussian grounded theory, there is a requirement to permit deductions from pre-existing theory to illuminate research problems, but the research must still ensure that these pre-existing influences do not hinder data analysis.

Within this research the aim was to adopt Strauss and Corbin's grounded theory approach, with a view to offer an insight into the way in which EERS sector practitioners and businesses interact with policy. For instance, the literature review details existing theory in the form of transaction cost analysis and stakeholder theory which is suitable to assess the supply chain and its performance enabling retrofit. From this, it can be stated that a specific strength of Straussian grounded theory is that it offers the researcher an opportunity prior to commencing data collection, to identify gaps within the literature. This in turn means that the

researcher is made aware of the existing research, and what would be novel within the area of study. One counter argument here however would be that examining existing work and theories, may cause a limiting factor to how the research could be conceptualised. In response to this is the statement that there was an intended effort within this research to ensure close attention was paid to data to inform the evolving development of emerging theory.

The Straussian grounded theory strategy also calls upon the constant contact of pre-existing theory and knowledge with the formation of a novel contribution of knowledge, via data collection and analysis. This procedure of constant comparative analysis, involves the constant comparison of original data with current data, sorted categories of data, and also theory throughout the duration of the research period (Bryman, 2012).This iterative progression of data collection, analysis and development of theory does not cease until theoretical saturation is achieved. This saturation is the stage at which added collection and analysis of data is improbable to deliver noteworthy added understanding of theory (Bryman, 2012). This stage is reached when no novel or relevant viewpoints are emerging concerning a specific data category, or when the category itself is well enough developed, or indeed the relationships between categories (Strauss and Corbin, 1998). However, this does lead to a viewpoint of concern for using this method, in particular the concept that these categories are unsuited to generalisations of findings due to the narrow focus of research (Bryman, 2012). Nevertheless, it is considered here that detailed assessment of phenomena and connection between different actors and EERS sector influences is a key stage in developing understandings of processes.

4.1.2 Qualitative Research Strategy

It is important that data collection and analysis methods were used which can best offer emergent insights. Quantitative strategies were considered unsuitable due to the fact that they fix meaning instead of permitting meaning to emerge. This stems from the concept that quantitative research aims to test existing theory, which requires a rigid definition of the research parameters. In light of the fact that there is presently limited understanding of the evolving retrofit policy arena and the EERS sector, it would be unfitting to test theories, without first offering insight into relationships. Subsequently, qualitative methods here were selected as a method of producing theory, related to the interplay between the EERS sector and policy. Qualitative strategies were considered well suited to offering in depth, detailed accounts of events and their drivers, as understood by people who have experiential

knowledge (Weiss, 1994). This suggests a general interpretivist epistemology, within which believed meanings of events are subjective and have been formed by humans (Schwandt, 1994). From this, it was intended here to utilise a selection of suitable qualitative data acquisition mechanisms, which have the ability to discover these subjective understandings of events. In particular, semi structured interviews, group interviews and focus groups were selected, to generate insights into EERS sector business characteristics and operational conditions, along with further analysis of how suggested route forward could be operationalised. Routes which could lead to retrofit at scale.

4.2 Research Strategy Summary

Within this sub-section a concise overview and visual aid to represent the overall research collection strategy is presented (figure 3).

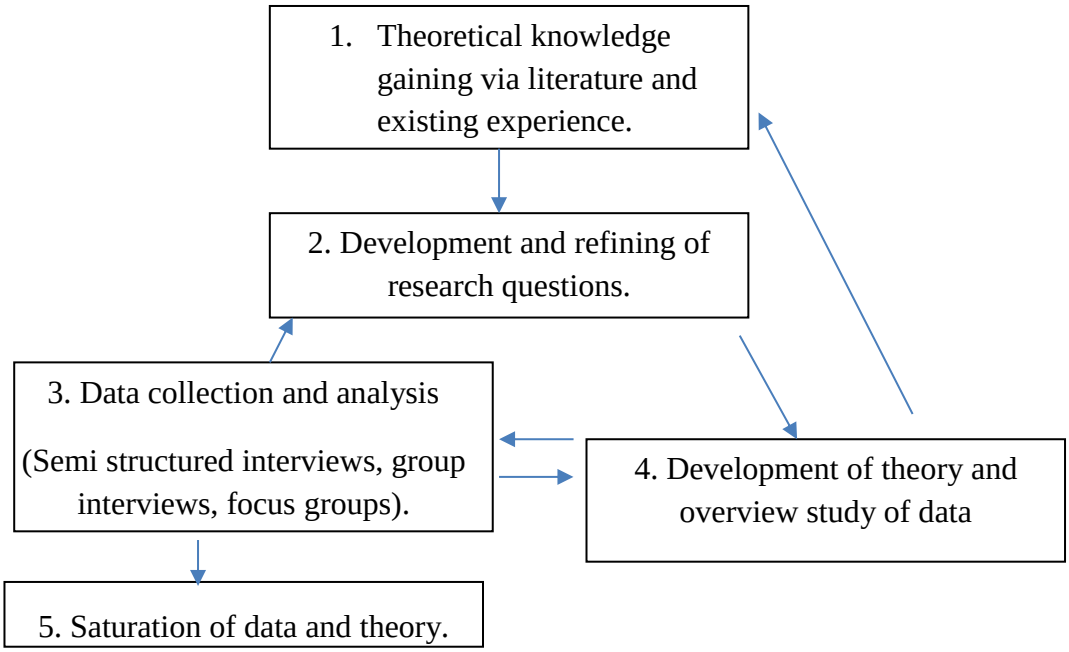

Figure 3: Visual overview of the main stages of the strategy to address the research questions.

The steps detailed within figure 3, are now discussed in further detail, within added identification of the decision making points associated with each stage.

Step 1 – Selection of concept which is under researched in existing literature (government based, industry based, and academic literature).

Step 2 - Research questions generated which aim to offer a valuable contribution to knowledge via the production of theory.

Step 3 – Strategy of data collection generated with the intention to produce adequate valuable data to address selected research questions. Analysis plan provides constant comparison to ensure quality of theory produced.

Step 4 – Operating alongside the collection and analysis of data, overarching viewpoints are required from the categories emergent from the data, these viewpoints form the development of new theory concepts.

Decision point – Once time has been taken to develop theory a decision is required to decide which route is best to take next:

Move back to step 1 – If during step 4 the identification of a need to gain more details on existing theory is detected to facilitate explanations of data, then a return to this step is required.

Move back to step 2 – If the research questions are deemed problematic, because they are shown to be too unrealistic, or indeed unrepresentative of the area of study, they a return to step 2 is required.

Move back to step 3 – If further data is required to enable more rigour in theory production then a return to step 3 is required to gain additional evidence.

Move on to step 5 – If saturation is met in both the data and also the theory being produced, collection and analysis of data can stop and a period of final insights refining can occur.

4.3 Staged Empirical Inquiry

Connected with the approach that grounded theory specifies, the structure of the research comprised of simultaneous collection and analysis of data. At the end of each step of data

collection, a break was considered a good opportunity to return to existing literature to ensure adequate theory investigation. This ensured the establishment of any link to existing theory which could assist in casting light on an emergent theory. An additional motive for staging the data collection into different steps is that it offered a period of time to gain feedback on data from participants to ensure accuracy and quality of data recording. This step was considered valuable in providing a validation of the data and can be referred to as respondent verification (Lincoln and Guba, 1985). Furthermore, this verification aided the formation of additional data collection steps.

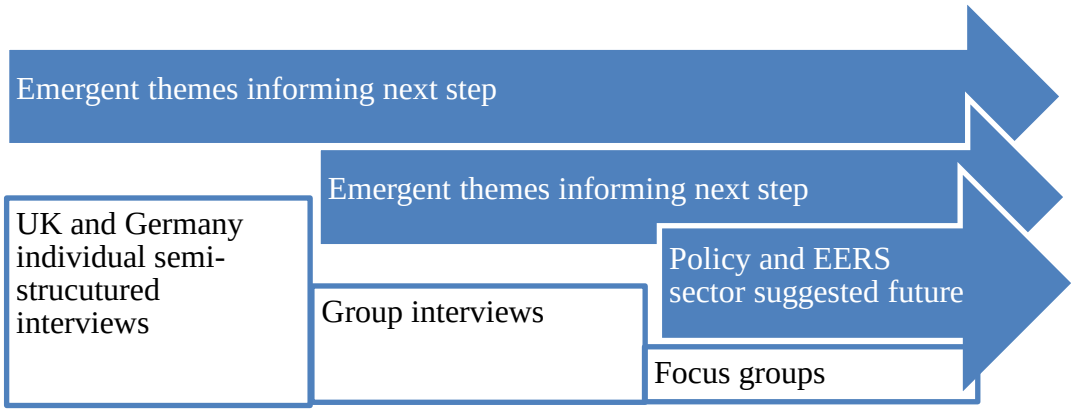

Figure 4: Flow chart displaying stages data collection strategy

The concept of a staged inquiry strategy is now elaborated upon further via information provided in table 6.

Table 6: Staged data collection strategy overview.

	Step	Method Aims	Strategy	Outcomes	Limitations
Individual semi structured interviews (UK and Germany)	1	To gain in depth experiential data from individual practitioners.	One to one interview. Facilitated conversation via open-ended questions.	Details of how EERS sector relevant policy has impacted the sector and related businesses.	Issues of representativeness, therefore point of data saturation used to assess required interview number.
Group interviews	2	Informal session to generate policy change suggestions.	Question all participants, and foster via direct questions significant inputs from all participants.	Opinions of themes emergent from within individual interviews as to the EERS sector and policy performance.	Due to the limited participant number moderator input high to ensure data quality and volume.
Focus Group	3	Produce environment where individual's policy suggestions are discussed, debated and clarified amongst a group of peers.	Facilitate a group whereby an informal question route enables space for participants to suggest and explain policy ideas to the group.	Production of policy ideas which are well formed due to group learning and discussion.	Moderation required striking balance of covering required areas and ensuring equal input.

The choice to use both semi structured interviews along with focus group emerged due to the exploratory nature of the research, attempting to gain in depth experiential data from participants. It is viewed that case study investigations also permit this in depth data at a more

focused level, however due to the varying nature of EERS sector businesses and participants, selecting a small sample for case study investigation would be minimal in its representativeness (Gerring, 2006). The concept of exploration was also the reasoning why a quantitative method was not made, for instance within questionnaires or surveys, detailed bounded questions are required. It is considered that due to minimal being known about the specifics of EERS sector and policy interaction that any questions produced by the researcher would not derive sufficient or substantial data to represent the participant adequately.

4.4 Step 1 – UK and German EERS sector practitioner semi structured interviews

Step 1 consisted of interviews at an in-depth level with individual practitioners to establish a basis of data regarding sector and policy interactions. The aim of this approach was to generate a detailed overview of the EERS sector, and to provide insight into the types of policy interactions practitioners have. Relating a comprehensive knowledge of: (1) the characteristics and processes of EERS sector practitioners and, (2) the policy and operation processes in place. This enabled an opportunity to produce theory which explained how EERS sector businesses may enable heightened retrofit activity.

The interviews offered an opportunity to gain an in depth insight into the UK method of working, and also permitted the first opportunity for questions and areas of investigation to be tested to ensure data collection procedures provide evidence addressed the research questions. This concept of research method refining, meant that data provided a basis for further assessment for validity via the additional German comparison interviews and also the UK based group interviews and focus groups.

The German interviews not only illuminated the status of the sector from another nation's perspective, but also offered a comparison of policy across national boundaries.

Within these interviews respondents were invited to discuss: (1) the key characteristics of the EERS sector and their own personal experience of the sector, (2) the interaction between the sector and policy, (3) drivers of change and rates of change within the sector, (4) practitioner opinions of policies, (5) practitioner suggested improvement for policy and sector. (Question outline located in Appendix A). In total, 14 interviews were conducted with UK respondents, in locations around the UK; however the majority of the practitioners operated either in Scotland's central belt, or in England's North West. Overall, 50% of interviews were carried

out over the telephone, and the remainder took place face to face, lasting anywhere from 30 minutes to one hour.

Participants covered details from their own personal experiences of operating within the EERS sector, in addition to more broad discussions of the sector and its development. Moreover the influence of policy was investigated, which provided in depth details and richness to the data. Interviews followed a guide (appendix A) which included a list of themes which were to be covered in the session (Saunders et al., 2009). Although the sessions covered similar areas due to this guide, specific questions varied from interview to interview due to questions following conversational flow (Saunders et al., 2009). Furthermore, supplementary questions were added if the respondent had made a significant statement connected to the research questions, whereby probing could gain insight (Saunders et al., 2009).

All interviews were recorded via Dictaphone on two different devices to ensure accurate recording, which enabled correct transcription.

Interviews were selected as the chosen method to collect data due to the fact that it provided access to other's experiences and observations (Weiss, 1994), and also because it represented a reliable method of investigating concepts and events not personally experienced. Interviews also permitted the opportunity for the researcher to discover the significances and clarifications that participants ascribe to particular phenomena (Blaikie, 2010), assisting in the identification of potential causes of these concepts (Yin, 2009). Interviews conducted in this manner, provided a view into the past, and generated an opportunity to construct a detailed image of a social concept or phenomena and also the drivers likely to be responsible for its development (Weiss, 1994). Interviews also permitted the illumination of possible routes of action and occurrences into the future. In reference to this research, participants were not purely requested to discuss their experiences and their opinion of the EERS sector and policy, but also to hypothesize possible developments into the future, in terms of predictions and observances of emerging developments.

In contrast to structured interviews, semi-structured sessions allowed the participant the option to select what they wish to talk about, to a large degree. This was hoped to mean that participants could lead the direction of the discussion into areas which were not considered as valuable areas of insight, but had the potential to offer contributions to the research. Furthermore, this technique gave participants the option to communicate and think aloud

about a variety of issues which they may have not considered previously, thus making connections during the interview. This strategy offered the researcher the potential to control the themes which were covered within the interview sessions and probe answers with follow up questions to ensure concepts were fully formed and discussed (Platt, 2002). Thus, the method provided a middle ground, to lie between structured and unstructured interviews. However, it is also acknowledged that there were weaknesses to the method and these needs to be discussed here.

The first weakness is that the interviewer needed to be conscious of the fact that the respondent may actually omit areas of information from the sessions, due to issues of confidentiality and trust for instance (Weiss, 1994). It was also conceivable that the way in which the respondent interpreted events meant there is not adequate enough information to pinpoint causal forces for particular events. Due to these reasons, a large dataset was generated, in order to generate triangulation (Weiss, 1994). To ensure against bias, it was also proposed to have open questions within the interviews schedule, thus permitting the respondent to provide a large range of responses to a particular question. Finally, in some cases, questions were needed to be asked in reference to a specific concept or phenomenon which the respondent had stated, therefore providing the opportunity for embellishment.

4.4.1 Sampling strategy for interviewees

Snowball sampling was utilised to gain participants for the semi-structured interview stage, before data analysis of these initial interviews provided indications of areas where further individual interviews and focus groups should focus.

Operating in line with the Straussian grounded theory strategy, this snowball sampling was then used to make a decision on where to look next for further data outside the researcher's existing EERS sector contacts, to add to theory development. This development of theory then informed theoretical sampling, which was used alongside snowball sampling.

The reasoning for snowball sampling within this research is that it is being used for an informal method to reach a target population and to explore the population of a research group (Hendricks, Blanken and Adriaans, 1992), and additionally the strategy is also being used to make inferences about the population as a whole (Snijders, 1992).
However, there are potential issues with the sampling methods, mainly the issue of representativeness (Van Meter, 1990). This lack of randomness is due to the choices made by

gate keeper respondents and therefore is not objective in nature (Griffiths et al, 1993). In turn this subjectivity could produce a bias towards producing what seems to be a high degree of social networks, and could omit to take notice of more isolated participants (Van Meter, 1990).

Although the researcher is aware of these constraints, it not considered an issue here due to the focus being on exploration of different types of EERS sector member and the variances in commercial strategy. Via the coupling of theoretical sampling, different groups of individuals were sampling to ensure a variety of business experiences.

What is an issue however is ensuring that any gate keeper or initial respondent can be trusted as an individual to commence the snowball sampling process (Moore, 1996). Within this research existing contacts were utilised in the first instance, to not only ensure experiential information would produce data address the research aims, but to also ensure that interview questioning was enabling high quality data.

To commence the snowball sampling method, initial existing researcher contacts within the EERS sector were utilised, to enable a base of interviewees who were known to have extensive sector operation. From these contact starting points, multiple strands of people were recommended as suitable subsequent participants. Following the initial snowball sampling, theoretical sampling was carried out, via the building of coding categories, themes and properties which emerged via the initial data gathering and analysis (Draucker et al., 2007). Theoretical coding acted as the central constituent of theory production and it commenced during the final part of the coding process, when the categories which had been generated were approaching saturation. The aim of theoretical coding was to organise the memos so that emergent theory would come to the fore and become identifiable. It is a key section of the grounded theory procedure and acted as a preparation process for writing up (Glaser, 1992).

It is this organisation of theoretical ideas which produced a comprehensive, multifaceted, and dense theory framework, as it highlighted different relationships between various coding categories and their properties. The sorting was essentially a piecing together of data produced in data collection into a complete picture of a particular area (Glaser, 2002).

Theoretical sampling focused on data conceptualisation and the categories which were developed and emerge (Puddephatt 2006, p15). This sampling meant that data must be searched for which provided an elaboration on emergent themes (Charmaz 2006, p102). This course of theoretical sampling produced enhanced consideration and differs from the snowball sampling used in the first stage, which focused in on using networks to achieve infiltration into the research population.

In this research, theoretical sampling was utilised to refine ideas which were evident in the first initial semi-structured individual interviews; the concepts arose from theoretical memos. This sampling therefore, identified areas in need of exploration and provided the researcher with an area in which future participant sessions needed to elaborate upon. The sampling of these interview participants was therefore determined by developed theory from the previous stage, and in turn highlighted the optimal type of participant to explore emergent theory. These stages of participant recruitment occurred once snowball sampling had been saturated, and pinpointing of theory exploration was required.

4.5 Step 2- UK based group interviews

The four group interview sessions completed within this research, were carried out with members of different professions. Between 2 and 4 individuals took part in face to face sessions. The first group was with Green Deal advisors and installers, the second with retrofit managers, the third with retrofit technology consultants and the fourth with retrofit material suppliers. The value of the sessions was significant, as group knowledge and group opinions of domestic retrofit policy and the direction it should be headed, could be generated. Furthermore, elaboration of opinions generated from individual interviews could be assessed, creating additional theorisation of particular concepts (table 6).

4.5.1 The value of individual and group interviews along with focus groups

Individual interviews as a method of data collection are the most common in qualitative research (Sandelowski and Barroso, 2002; Nunkoosing, 2005), and they are mostly used to collect accounts of respondents' experiences and knowledge. There is evidence to suggest that focus groups and individual interviews when combined can be advantageous to produce complementary viewpoints of a particular theme (Lambert and Loiselle, 2008). This complementariness is based around three points, firstly the use of interview and focus groups to provide comparisons and contrasts between individuals viewpoints, secondly due to

pragmatic resource limitation reasons, and thirdly due to attempts to produce a completeness of data, or to confirm data. Unlike in some research structures where interview participants are utilised within focus groups (Taylor, 2005), this research utilised the methods in parallel. This meant data from different individuals could corroborate data and provide additional credibility.

4.5.2 Different sizes of groups

In many cases focus groups and group interviews are terms used interchangeably, in market research for instance, however, a focus group can be termed as a group consisting of five plus participants, led by a mediator (De Ruyter, 1996). The interaction between individuals is a key feature here, as this is the type of atmosphere which can create group clarification and exploration of views (Kitzinger, 1995). This is of importance here to suggest improvements to retrofit policy, for instance. In comparison to the focus group which consisted of 5 or more participants, the group interviews took place with a smaller group, and did so to achieve different aims. This is due to questioning and clarification between more people not being possible, unlike the focus group.

The group interview is a method which due to the limited number of participants entails the systematic questioning of participants, to ensure that all individuals have some input to the session. This systematic approach means that the technique has some elements of formal and informal interviewing. From this fact, it can then be appreciated that the main differences between group interviews and focus groups are the differences between the ways in which the sessions are conducted. Unlike the discussion and exploration nature of the focus group, within the group interview, the moderator of the session directs the questioning and the interactions amongst participants in a variety of different ways, whether structured or not, depending on the purpose of the session. This purpose could be exploratory whereby a group of people are brought together to test a theory on a subject, or to establish a research question. Linked in with the exploratory usage, group interviews can also be used to recall events, share experiences or to triangulate data (Cicourel, 1974). Furthermore, group interviews also have the possibility to take on a number of formats depending on the purpose. Informal mind-mapping sessions may be required where little direction is applied by the interviewer, or at the other end of the spectrum is a Delphi style structured market research style session. Additional format differences are in the way in which the interviewer leads the group, whether it is in a formal or informal way. In the case of formal sessions such as Delphi or

nominal groups, a strict structured strategy is adopted whereby participants share their opinions via the moderator, not with each other. At the other end of the spectrum, less directive approaches can be used to enable more established group networks to discuss and elicit interactive discussions.

In the case of the group interviews conducted within this research, the sessions were determined as exploratory in nature, due to the research questions focusing on the EERS sector as to the future of the sector and related policies. Therefore permitting respondents the opportunity to discuss freely their thoughts and via discussion define in greater depth, their reasoning's. The fact that the groups of the individuals already had some similar shared experiences, from all operating in the EERS sector, also meant that a less directive approach was adopted by the interviewer. This more informal, unstructured method permitted the group to interpret each other's responses and carry out a discussion from the groups combined opinions. This entailed the leading of the session via focusing on emerging themes from within the individual interviews. It can therefore be stated that the group interviews, in their focus on participants leading the session were similar to the ways in which larger focus groups are carried out. However due to the fact that participants volunteered, there can be deductions to suggest that all individuals wish to contribute. Therefore there is the need in both focus group and group interviews to ensure that all participants have the opportunity to speak, and not be spoken over by a more confident peer (Merton, 1956). Thus, the key difference in the strategies is that with the smaller number of members in group interview sessions, more structured questions were required in comparison to focus groups (Merton, 1956).This specific targeting of questions to all members also enabled maximal coverage of any particular topic (questioning guide located in *appendix B*). This is different to the strategy undertaken within focus groups which permitted the group to discuss themes more independently and ask questions amongst themselves.

4.6 Step 3 -UK based EERS sector focus groups

Focus groups used within a UK context offered an overview of the sector and policy, and how different interactions cause practitioners to react. In addition, via the group knowledge and experience at focus group stages, data became more robust in suggesting areas where policy packages were or were not working.

It is considered that to provide sufficient data, methods were coupled to offer wider assessment of policy/sector interaction, assessment which is at a higher level than the individual person or business level. In this instance, the wider views of focus groups, provided arenas for a specific section of the EERS sector to come together to discuss, as a temporary network, their collective relationship to policy. The base of data gathered in step 1 and 2 was utilised within the focus groups as a basis for questions and prompts. This staging to steps 1, 2 and 3 was considered to focus on emergent features from the industry; to take the seed of an idea or concept and assess it in depth.

Multiple focus groups were carried out with individuals operating in different EERS sector roles, to generate varying opinions of concepts from a wide range of industry standpoints. It was considered here that the organisation required to bring together a German based focus group was too much for the remit of this project. Therefore the UK based groups acted as a method of providing data to inform the UK based side of the research, and also provided a comparison to German interviews.

4.6.1 Focus Group Data Collection

Working from initial research, existing literature and also data collected in step 1, focus group participants were selected who were deemed to have significant experience of concepts which addressed the aims of the research. Therefore from a group session, discussion occurred where different ideas regarding the EERS sector and policy, could emerge.

Question themes for focus groups

The focus group questioning themes were divided into three areas, in which each were structured around a series of questions. These questions were elaborated from data analysis carried out within step 1 and 2. (Focus Group topic guide located in *Appendix C*).

> Theme 1 assessed the nature of each participant's involvement within the EERS sector, and what changes if any they had seen the sector undergo.
>
> Theme 2 addressed the participant's interactions with policy and what interactions had succeeded or not in bringing innovation and growth.

Theme 3 looked at pinpointing the different influential factors affecting the performance of different packages of policy mechanisms, and followed up with suggestions of how group participants would change the policy landscape.

The researcher's role within the focus groups was to channel the group and keep participants on track to cover the above themes. In addition, particular attention was paid to the nature of the group network itself; how different individuals viewed the stakeholders of the sector, not simply the economic and political areas. The sessions were recorded and transcribed prior to coding. Analysis entailed coding to divide the data into different themes, with results being made available to participants. Particular attention was made to consider the regularity, comprehensiveness and intensity of remarks made, and deliberation was also given to what perhaps was left unsaid by participants (Krueger, 1998). Quotes were then extracted from the transcribed material to highlight themes, with attention being paid to the context in which the remarks were made.

Focus group considerations

In contrast to individual-to-individual interviewing, focus group dialogue was a more active and energetic communal discussion, meaning an accumulative understanding of the recognised issue could be realised. This therefore resulted in the "development of shared knowledge" (Holestein and Gubrium, 1995, p.71).

Focus group interactions in this arena produced data resultant from diverse experiences meaning a wide range of extensive evidence was produced. This is due to the nature of communication within the group allowing contributors to remark and shape developing issues. As this building and shaping of issues could not be gained via individual semi-structured interviews, focus groups were considered most suitable for establishing group opinions and debate points. It was also proposed to use focus groups for its methodological benefits, as analysis of key narratives from focus group conversation enhanced validity and reliability when assessing interview data. As the research looks into comparing different national EERS sector/policy interactions, more than one focus group was required to permit adequate investigation. Carrying out more than one focus group offered a growth in data reliability by identifying agreements across different groups (Morgan, 1997). In this

framework, points of debate or discussion developing from one focus group contributed to theory production and therefore contributed to following groups as triggers of conversation. There is however, little consensus regarding the appropriate quantity of focus group discussions to be undertaken in research. Barbour and Kitzinger (1999), suggest the saturation method should be used, in which focus groups continue to take place until no new data arises. Current research rejects this statement however, stating that given the fact focus group discussions are not the only method in use when utilising mixed methods; the saturation practice for focus groups alone, is not applicable. Ressel et al., (2002) take the discussion further by stating that when a multifaceted phenomenon is being studied, carrying out focus group until saturation could lead to a limitless number of issues being discussed, complicating data analysis.

Focus Group composition

In this research the configuration of the dialogues within focus groups was considered a key area where attention was required. This was to improve the communication among group members and therefore offer greater rigour within the data. One key concern included the lack of commonality between participants. Subsequently it is considered that the greater the commonality in experience between groups, the more likely group members were going to be vocal regarding their standpoints of the EERS sector and related policies, and discuss developing themes (Krueger, 1994).

Focus group sampling

The decision regarding the size of the focus group sample was grounded within the growing deliberation around this issue. Although it is considered a larger sample affords data which is richer in context, it is considered difficult to oversee groups and ensure that every participant contributes (Barbour and Kitzinger, 1999). However, it is also viewed that a smaller sample (< 4) produces an environment where diverse interaction between group members is thwarted (Morgan, 1997).

The focus groups within this research had around 4-6 participants, although this is a relatively small number, the intention was to gain information regarding detailed concepts covering policy impacts on sector practices. Consequently in many ways the depth of discussion was

more vital than focus group size. This also meant, groups were not too small, stopping any restrictions upon interactions, and yet they were not overly large that they could not be managed. Plus, focus groups should not be viewed as representative of the entire population (Strauss and Corbin, 1990); this is due to participants self-selecting themselves, or volunteering. This process means that focus groups can be formed of individuals with a higher level of interest within a theme than the general population. This intrinsically means that self-selection limits the level of representativeness. This was not considered an issue here, as the depth of interest from participants was considered important in generating in-depth discussions regarding complex sector issues. Plus, with a group demographic which was knowledgeable and thoroughly interested in the research, it was thought to offer a good foundation of material for theory production.

To collect participants, theoretical sampling from steps 1 and 2 provided details of the types of practitioners which would provide the most illuminating data related to the themes emergent from the initial interview data. Type of practitioner revolved around the role and experience of the individual in relation to the types of concepts that are considered in need of additional investigation, in a similar manner to the latter stages of the individual interview sampling method.

The result of this theoretical sampling strategy, produced focus groups which were formed of participants who were operating on projects together. This strategy was selected due to the stated high importance of temporary project networks, and relationships between supply chain actors within a project setting. Therefore in utilising groups who had shared experiences, not only offered added insight into how networks operated on the ground, but also ensured participants felt comfortable to partake in conversations and debates around future EERS sector strategies.

Focus group potential problems

As is the case with other research methods, discussions within focus groups can offer up some issues. Firstly, due to the relatively small size of the sample, the ability to generalise the data can be challenging. Similarly, it is considered that there is the possibility that participant's data is founded within particular social contexts (Morgan, 1997); therefore the group discussion reflects the personal situation of the participants alone. However, within the

setting of this study's aim and objectives, this suggested limitation is considered weak. A central aim of the focus groups here was to establish in-depth insights into how particular practitioners encountered EERS sector policies, not to provide generalisations. In many ways this lead to theory production, rather than statistical generalisations, when multiple focus group data sets are considered. A second issue is that some participants could have simply sided with the majority opinion. It is considered that this problem was addressed via the interventions of the group moderator (researcher), encouraging the full participation of group members.

4.7 Ethical Considerations

The role of the researcher can be seen as creative or indeed subjective; the concept that there is a creation of a new version of reality constructed via research (Law, 2014). This suggests that the key point for researchers to focus upon is how to capture the truth of reality; what key factors to focus on, what needs to be included or not, and what type of narrative does the data require to enable the illumination of this reality. These choices are in essence ethical, as they determine the way in which relationships and knowledge is understood within the studied community. In the case of the EERS sector, correct representation of the key concerns for practitioners was paramount, as the influences impacting them and their businesses are widespread. Plus, due to the contested nature of policies in place affecting the EERS sector, ensuring data is characterised correctly to show the intricacies of the political-socio-economic relationships is vital.

Saunders et al., (2009), state that the collection of data is related to a large range of ethical considerations, and these factors should be deliberated and acted up on within the research strategy and design. One area of consideration is related to the importance of participant consent (Weiss, 1994). This is why all participants within this research were provided with a document detailing the proposed outline of the interview or focus group and also the purpose of the research as a whole. Respondents were also provided with consent forms, which they were required to complete and sign, so that they could offer permission for data which they provided, to be used within this research.

Furthermore, as the researcher was aware that within the business world, many pieces of knowledge are confidential, correct representation of information is commercially important. Therefore, prior to participant selection, details of the research solely wishing to gather data

on policy measures, and how they work within a commercial environment, were sent to possible participants. This explicitly removed any notion that data was required on private commercial or financial themes. In addition, in presenting participants with the data interpretations and analysis post data collection, any information which they felt was something they did not wish to share, could be removed.

In utilising qualitative methods, and focusing on the experiences of the people operating on the front line of the EERS sector, this research acknowledged the diversity in the ways in which knowledge is constructed, from experiences, ideas, and communications. Therefore, one feature of this research which requires reflexivity was the extent to which the study was critical of how the EERS sector had progressed to date. Moreover, the positioning of this research is a politically delicate issue, as the policies recently affecting the EERS sector within the UK received mixed responses from different parties. In many ways the research topic is a lively political issue, with many houses in need of retrofitting leaving their occupants in fuel poverty and unhealthy living conditions (NEA, 2008).

Considering these issues, the focus here was on what practices within the EERS sector were being hindered, or were not being assisted by policy packages designed to aid the sector. In this way, suggestions are not being made as to where the sector or policy makers are not producing effective results, but instead suggestions are made as to how the process of policy learning can be continued. Coupling private industry and policy in this learning process is of high importance here as the EERS sector has unprecedented responsibility in delivering retrofit at scale.

A further ethical consideration was that participants, in accepting the invitation to partake in this research themselves, could have considered themselves exemplars of particular achievement when it comes to succeeding within the EERS sector. Indeed they may have believed policy had particularly not treated them as well as others. This could have caused problems with the usefulness of the responses when it came to deriving large scale deductions about the condition of the EERS sector/policy relationship. Nevertheless, it was considered that as EERS sector practitioners, all possible insights into the state of affairs, no matter where it is on the spectrum, were valid. In utilising triangulation within the mixed methods approach, the aim was to minimize the overall effect of outlying opinions.

4.8 Data management

Data was gathered in recorded spoken word, and therefore required transcription to enable detailed analysis. All transcriptions were completed by the researcher to enable greater immersion in the subject matter. There are suggestions from literature for reserving transcription for only selected pieces of data, which are deemed significant. Within this research however, transcription was carried out for all recordings, completed to alleviate the risk of losing data which may have emerged at a later date as being important.

QSR NVivo 10 (Bringer et al., 2004) was the data management tool of choice to enable analysis and to generate an efficient, reliable method to categorise different text, and to enable effective cross referencing between data generated by different methods. A framework was utilised to enable the *iterative* modification of data as analysis and themes developed. This reflects the need for the fine tuning of data interpretation over time. The coding framework was developed by using the data and also the key objectives of this study. Reflection of the objectives and data in this manner, was in line with the grounded theory approach selected (Strauss, 1987), and was designed to enable the identification of themes most relevant to the research. Furthermore, the ongoing data analysis which was used within this research and suggested by grounded theory commentators meant that ongoing verification and general inspection of data for possible categories were required. These categories were then analysed, with the aim of generating emergent theories regarding possible categories. In utilising this method, a technique which generated constant analysis relating to wider concepts, whilst still concentrating on the specific nature of the data itself, was achieved (Glaser and Strauss, 1967, p.102).

This coupling of the use of QSR NVivo and grounded theory was of importance due to the fact a qualitative data management tool could offer a move towards an explanation of the subject, grounded in the data (Bringer et al, 2006), a step beyond a thick descriptive explanation. NVivo in-particular, via its inclusive nature, can display different data sources simultaneously, enabling heightened transparency (Bringer et al., 2004). Furthermore, NVivo offers memo tools, to log details of opinions of data segments, contributing to the formation of theory. This ability to form a diary of research plus offering a link with existing literature generates the option to produce early indications of possible theory, which in this study impacted sampling decisions and questioning routes for theory verification. Aside from these factors, a key decisive factor influencing the choice of NVivo is that it permits the inclusion

of many different types of data, from transcripts, to documents, to notes. The use of mixed methods in this study offered up many different data types, meaning the ability for NVivo to allocate different nodal meanings, was of particular appeal. This categorisation therefore generated the identification of concepts which could lie within different nodes (themes) and sub-nodes, contributing directly to grounded theory and the growth of theory from data (Bazeley and Jackson, 2007). Appendix E explains the coding and nodes structure created during the course of this research.

4.9 Data Analysis

At the centre of the grounded theory approach is the combining of two data analysis processes, as proposed by Glaser and Strauss (1967). The first of the processes involves the coding of all the collected data to verify a proposition, the second method entails the general inspection of data for possible categories, these categories are then analysed for the development of theoretical concepts. In combining these two methods, a technique which can generate constant analysis relating to wider concepts, whilst still concentrating on the specific nature of the data itself, can provide an approach offering different scales of data evaluation and analysis (Glaser and Strauss, 1967, p.102).

An understanding of the wider contextual landscape can be produced by working with the data, as it can be applied to the research objectives in the most effective way. This further develops objective conclusions as the analysis evolves. This evolution involves data working and reworking (Crang, 2003, p130), in addition to the formal coding process. This concept of continually working with the data means that analysis may continue through writing, and in turn influence the conceptual development of the research (Crang, 2003).

4.9.1 Interpretive research and ensuring rigour

The concept of rigour within interpretive research and the processes which should be used to ensure it, have been outlined within different literature sources (Corbin and Strauss,1990; Chiovitti and Piran, 2003). From this wealth of resources, different standpoints have been generated detailing the best way in which to address this issue. In empirical study ensuring reliability, validity and generalizability is more of a straightforward task due to definable mechanisms being present to achieve these factors. Within interpretive research however, the level of transparency is relatively much less.

The main issue when carrying out qualitative data analysis is that a singular method of assessment does not exist. Instead the role of finding the most appropriate route of assessment falls to the researcher, and therefore the assessment of rigour must result in a methodology which is a true reflection of the data (Corbin and Strauss, 1990). There have been various different criteria advocated for defining the level of rigour within interpretive study, with the majority stating that the more traditional concepts of reliability, objectivity, generalizability are in fact insufficient when working in an interpretive manner (Glaser, 2002). It is not that these determinants of rigour are entirely incorrect, but instead that they need enhanced depth to aid the highlighting of the qualitative content of the data. From this therefore, concepts such as credibility, transferability and auditability (Lietz and Zayas, 2010), are utilised instead. An overview of these terms aimed at producing rigour is discussed below.

It is suggested that credibility be utilised as a substitute to validity, therefore, instead of focusing on how much truth is within an assessment criteria as internal validity does, credibility should centre on whether the researcher has been truthful to the information gained and also the sources of data (Glaser, 2001). In order to achieve this faithfulness to the data, the researcher is obliged to accurately document participants, data, and the environment where the data collection was carried out. Furthermore, there should be in depth analysis and understanding of how the researcher impacted the participant, following this process results in participants being able to identify with their own sentiments within the write up, or indeed for different contributors to acknowledge a trend as being true.

Within this study, the pillar of credibility was built upon deep description of the participants, including their own personal past, present and future, along with the business or organisation they work and operate within. This offered an indication of the progression of the EERS sector in business and economic terms and also in terms of employment and career development. Plus, audiotaping of interviews and focus groups was carried out, to ensure quality and accuracy post transcription; these transcriptions were checked multiple times for added accuracy (Siccama and Penna, 2008). Credibility was established further via conversations and piloting of questions with existing EERS sector contacts, producing a screening process to ensure that question schemes could produce rewarding data. Lastly, memos acted as reference points to aid the creation of credibility, and the researcher journey with the data could be recorded and tracked.

In the case of transferability, there needs to be consideration regarding how the research can be generalised or how strong the data's external validity is. In essence, how far can inferences regarding participants be made about the sample population. In quantitative research for instance, it could be said that much of the answer to this questions resides within the sampling techniques used, and how much the sample is representative (Corbin and Strauss, 2008). In interpretive studies however, the sample sizes are regularly confined and relatively quite small in relation to empirical research. Therefore the ways in which the data relates to the transferability factor is different. It is suggested that if participant experience is recorded in depth, then it does have value in terms of representing a percentage of the wider population. It is considered within this research that due to the presence of initial test interviews with researcher contacts, that the investigation techniques could be validated as successful with respondents.

In terms of grounded theory there also needs to be a step away from the concept of repeatability or replicability and instead a view of whether the research is auditable should be taken. This is because when considering replicability, the concept of whether research can be repeated is important (Locke, 2001), when in actual fact here the concept of authentic representation is far more significant. This research strives to produce an accurate representation of the participant's views, opinions, experiences and descriptions (Corbin and Strauss, 2008). To achieve this, a focus upon the individuality of a participants experience was adopted, with an understanding that this experience could contain contradictories and a high degree of complexity. It was not a quest to provide definitive answers but instead to produce a more well-rounded view of how individuals interact with the world around them. Thus, 'auditability' was utilised here, as a more accurate word, and was operationalised via detailed documentation of decisions and the creation of an audit trail. This trail created the option for an external party to be able to follow the researcher, and in turn reach similar outcomes. Literature suggests that this audit trail consists of as much description as possible and can include field journals, reflections on data analysis and details of the sampling process and participant recruitment. Within this research this trail was supplemented by memos, examples of statements from within the data, along with extracts from existing literature.

4.9.2 Coding of qualitative data, and constant comparison

Via the coding process, constant comparison along with theoretical sampling could take place with data extracted in a systematic manner and transferred into theoretical explanation. This

systematic manner of extraction included the concept that analysis was ongoing whilst data collection was taking place. For instance theoretical sampling was utilised to select participants in line with criteria emergent from initial findings. Plus, this early stage analysis highlighted specific factors in need of further investigation, reinforcing the requirement for sampling to support developing theories. From this stance it can be stated that the continual cycle of inducting and deducting, or the collection and subsequent continual comparison between results and emergent findings, generated on-going changes to the method of data collection (Strauss and Corbin, 1990).

This cycle of induction and deduction to identify concepts acts as a key area of the grounded theory way of working. This identification compares the rate of incidence within the data of themes which are reoccurring, which then enables the classification of different categories of conceptual thought. The categories are then advanced via the comparison of other data sources containing these emergent themes. This is a process which is not focused purely on explaining or describing how themes are similar or not, but by creating categories saturated by the data, and therefore as fully formed as possible (Glaser, 2001). The production of these categories of concepts is not generated via the singular incidence of a theme, but instead via the constant comparison of different markers, until a category starts to overlap with another, indicating saturation of themes (Holton, 2007).

The initial step of constant comparison is the process of coding and carrying out a constant comparison of all of the different occurrences or incidents of data. This then produces a draft category list based on the underlying themes. It is important to state that category creation must be based upon multiple occurrences of relevant data (Glaser, 1998). Once the initial framework of categories has been produced, emerging themes must be compared to other established themes. This second comparison stage is required to expose and incorporate any similarities between themes (Holton, 2007). Lastly by way of progression to a phase whereby concepts regarding the data are specific and well formed, concept to concept comparison takes places. The aim here is to account for data variation and also provide conceptual theories which are integrated and not overly general.

4.9.3 Data coding operationalisation

The coding of interviews and focus group transcripts here acts as the first stage of analysis, as it creates a move away from simply particular statements to more abstract interpretations (Charmaz, 2006). The coding process here is focused on three stages; open, selective and

theoretical coding, all which contribute in their own way to the understanding of data, and generation of meaningful conclusions.

Open Coding

The process of open coding takes place in the primary analysis stage, and entails the coding of data for all possible themes or categories (Glaser, 1978). Throughout this stage, data analysis is carried out methodically and on a word by word basis, with a focus on maximising the possible areas of theoretical categories. The naming of codes at this stages is formed from the data directly, such as words used by participants during interview. The revision of names then takes place on a continual basis to guarantee the most accurate representation of the data within a category (Glaser, 1998). Although there is a school of thought which states that this coding in a methodical line by line way produces simple descriptions of data, instead of the theorisation of concepts (Stern, 2007), questioning of data can overcome this (Holton, 2007). Questions such as; which category does this data best represent, or what is this data section indicating, act as a preventative tool and as a method of promoting a prioritisation of theoretical concepts and connections between them (Glaser, 1978). Open coding continues until a central group of categories surface, which is located at the heart of the data and is connected to multiple other categories (Holton 2007). Once this is achieved, grounded theory data analysis can then progress to define the concept within the data via selective coding.

Selective Coding

The core categories established via open coding form the key areas of data for selective coding, therefore the process of establishing a central area of theory is created. As the analysis advances it focuses increasingly upon a more defined area of data, meaning that grounded theory forms a more deductive than inductive stance. Via the selection of the central categories to the research, the remaining categories are not deleted but instead adopt a secondary position (Glaser, 1978). The selective coding then continues until the saturation of the central categories occurs, and the conceptual theories behind the data become increasingly defined. This selection completes the second step of coding as stated above, and ensures the absence of coding replication. Once this definition of theory is present across all of the concepts produced during analysis, theoretical coding can commence.

Theoretical Coding

Designed to investigate the connections and relationships between the core categories of themes and their properties, this stage's aim is to create a selection of hypotheses that form the overall framework of theory (Holton, 2007). This therefore means that the theoretical code is an outline structure to integrate all the different theories produced via the two previous steps of coding (Glaser, 2005). Although theoretical coding can take place via the process of constant comparison, the actual integration of theory needs to occur with the use of ***memos***. Utilising memos enables the researcher to record any thoughts on the codes or categories themselves throughout the entire analysis process. Via the organisation and analysis of these memos, relationships between data sets can occur, which in turn can assist in the locating of different thoughts into the theoretical structure. Within this structure, Glaser (1978, 2005), states that the researcher should input multiple theoretical schools of thought, of which there should be as many as possible. The meaning for this is that it offers familiarity and connection with the relevance of any emergent concept within the analysis process, and it also enables the data to be viewed from multiple standpoints, whether that is economic, social, philosophical etc.

The use of memos here acts as a suitable way to offer constant comparison and occurs at all stages of coding, and is therefore a key part of grounded theory. Memos act as a method of capturing, following and retaining concepts (Glaser, 1998), and take the format of notation attached to a section of textual data. The emphasis of memo writing is one whereby free thought is encouraged, to establish connection and hypotheses as well as form the definition of the final theory (Glaser 1978).

Theoretical memos here form foundation stones which enable theory generation and also as a reflective tool to permit the researcher the opportunity to assess and produce meaning from the data (Mills et al, 2006). Glaser (1978) goes so far as to state, that memos form such a central part to the theory, that without them the researcher is not completing grounded theory. Memos create the opportunity for researchers to record their opinions and ideas of emergent concepts (Glaser, 1992), which in turn keeps track of any areas which are embryonic or developing. Memos, although based on the ideas formed within the researcher's mind, they are also formed within the data, and therefore are also grounded. Memos provide the first step in substantive theory development and thus reported, as they provide, a distillation of the analytical process (Glaser, 1978).

Within this research memos performed the following roles;

- Memos developed ideas theoretically, via the recording of connected implications and thoughts to a transcripted segment. Therefore in using memos to ground theories within the data, emergent information within different stages of data collection, could be theorised and taken forward for further investigation within later data collection sessions. The overall increase of analysis level, from data to codes to categories, leads to the understanding of when data saturation is met and also the development of theory (Glaser, 1978). For instance, a theme which appears at individual interview stages could then be coded and memos applied to a theory the segment represents. This theory is then taken forward to group interview to refer the theory to other participants, to assess it validity. One example of this was the expansion of theory of quality in relation to subcontractors. Initial individual interviewees commented on the negative aspects sub-contractors had upon the public perception of the sector. Then upon expanding this point at group interview stages, the concept that sub-contractors could aid adaptability to workloads emerged. The two sides to this discussion was then referred to focus groups sessions, where strategies were called for, which could enable increased communication with sub-contractors to appropriately deploy them in a quality highly trained manner.

- Freedom for idea development: following on from the previous point regarding a lack of restrictions upon the researcher when completing memos, the second goal is to ensure that the researcher only has to be concerned with recording ideas as they emerge and not be concerned with any formal rules (Glaser, 1978). With an industry such as the EERS sector, this is of particular importance due to the limited existing research, and therefore minimal preconceptions as to what theories are affecting the sector and what themes are most important to participants.

- Memo fund formation: the third goal of memoing is to provide a bank of memos which, once organised can provide material to enable a successful write up of the data. Therefore from this, theoretical memos need to be written and recorded across the entire course of data analysis. Furthermore, the bank of memo can perform the role of informing articles and presentations which are related to the overall research project (Glaser, 1978). As can be seen within appendix F, the range of memos formed was wide; meaning the freedom to form different theories was available.

- Focus on being highly sortable: the fourth goal for memoing is to ensure that memos permit easy access for the researcher, to ensure that there is ease and efficiency in theory developing. Therefore from this all codes are to be titled with reference to the category to which it is related (Glaser, 1978). Taking the example of EERS sector practitioner training, the following are sample interview text extracts, memos and theories emergent from the data (table 7). From these theories, probing questions were taken to subsequent data collection session to expand on them further.

Table 7. Example Memo strategy

Original transcript	Memo	Resultant theory
The conservation nature of the UK market means that we are treated in my opinion somewhat with suspicion, which we are trying to get one over the end user.	Move away from traditional side of construction as connected with untrustworthiness	**Training increases needed multiple benefits possible;** retrofit professionalism and emphasis on training required to offer superior service than previous construction industry practitioners.
It's all very well have really high performing products, but unless they are installed correctly, all that is going to happen is thermal bridges and draughts are going to detract from the way in which they perform, and the benefits of the products are going to be lost. In many ways I think that if products were fitted correctly now, we would not need to invest in lots of new products.	Skills base not advancing fast enough to keep up with innovation and technology improvements.	**Training increases needed, multiple benefits possible;** training is a key way in which to enable increase project quality and therefore boost customer journey quality.
When you are working to higher building envelope ratings, if you produce something of quality the level of performance automatically follows.	Skills base increased affect level of project performance.	**Training increases needed, multiple benefits possible;** in increasing practitioner training, project performance and carbon saving will also increase.
When they (practitioners) are better at a wider range of jobs and processes, it means that a project can be completed more efficiently and in a streamlined manner, because there is a step away for the concept of specialised working.	Increasing professionalism and quality can inherently offer streamlining advantages.	**Training increases needed, multiple benefits possible;** investment in training brings process efficiency and project performance increases.

4.9.4 Achieving theoretical saturation

The concept of saturation in grounded theory is when data gathering ceases and saturation transpires. In this case saturation can also be termed as 'data adequacy', the notion that no new data is emerging as collection continues (Morse et al., 2002). This can be furthered to state that saturation occurs when data stops providing new theoretical understandings (Charmaz, 2006). It is important to note here however, that this saturation is not simply and purely related to the repetition and frequency of data occurrence. A key aspect to the analytical processes of the data assessment it to ensure that all data is given equivalent consideration (Meadows and Morse, 2001). This therefore creates a focus on achieving a wealth of data from detailed descriptions, and not simply how often something is stated. This is of particular note, as it may be that key pieces of data emerge, which do so infrequently and yet provide a crux to the understanding of a phenomenon.

This concept of acknowledging that smaller references to themes does not mean insignificance, is also a viewpoint that should be applied to sample sizes. This is due to the fact that although a sample may be small, the impact of statements upon answering the research questions may still be achievable. Stern (2007) even goes so far as to state that a grounded theory study needs to step away for large amounts of data, and instead look toward representativeness. It is suggested that with large datasets, there is the risk that files may go unanalysed, and the focus of the research lost. The idea of saturation and if it is achievable in any way, has been debated in light of this, instead of the very absolute term 'saturation' instead the more measured term 'theoretical sufficiency' is suggested to designate data adequacy (Charmaz 2006, p114). This sentiment is determined by the fact that saturation may actually be caused as an effect of the researchers focus; categories could simply be saturated by researcher choices, not purely by data (Charmaz 2006, p114). So from this standpoint, data collection here continues until innovative theoretical insights cease.

4.9.5 Theorising

Theorising acts as a method of generating understandings, information which needs to be frequently reviewed and updated as research progresses. In this research, using the constructivist grounded theory approach, means that the assumption of generating abstract theories is challenged and instead 'situated knowledges' are produced (Charmaz, 2009). To achieve theses 'knowledges,' the flow of study should be halted, the experience dissected, and then when theorising, a reaching down to the fundamentals and experiences needs to

occur (Charmaz 2006, p135). Therefore this research involved the abstracted conceptualisation of data, linking data with more theoretical ideas, at all points of data collection and analysis. It was the responsibility of the researcher to reflect upon the very business centric data emergent from EERS sector practitioners, to make abstractions to link to theory. Although this is considered a stance of high responsibility for the researcher, it was an important process to undertake due to the lack of existing EERS sector research. In addition to the researcher role to conceptualise data, there is also a need to see through the spoken words of respondents to the large situation in which they are in, and the processes at work (Locke, 2001).

So in this research, the focus was on gaining experiential knowledge and opinions with EERS sector practitioners; conversing with them and obtaining an insight through anecdotal evidence. As suggested by Glaser and Strauss (1967), the use of substantive theory can produce a set of explanations which provide a reason as to why a particular phenomenon occurs. A theory produced in this manner, may be an end in itself, or it may be able to be developed further to form a formal theory, via increased levels of abstraction and conceptualisation (Lempert, 2007). Central to grounded theory investigation is that the theory established emerges from the data itself instead of fitting with prevailing theories forcibly. Therefore the theories produced within this research look at data derived thoughts on EERS sector characteristics, capabilities, prospects, attitude and downfalls. These areas of investigation are placed within the work of previous authors, to display how the research has furthered knowledge (Stern 2007, p114).

4.10 Chapter Summary

This chapter has detailed the methodology this study utilises and offers a justification as to why this strategy has taken the form it has. The following section will detail the results produced by the application of this methodological approach.

Chapter 5. Results

Based on the methods used, this chapter is split into five distinct areas. Firstly, UK specific EERS sector characterisation takes place (5.1), which uses individual interview data from within the UK context to form a foundation of the sector and the different aspects of what makes up participant businesses. Secondly is an assessment of EERS sector performance, in terms of how UK individual interviewees have experienced and dealt with a variety of policy and incentive schemes (5.2). Thirdly, themes which emerged from within individual UK interviews are assessed in greater detail, via group discussion within the UK concept (5.3). Fourthly, the perspective of German EERS sector practitioners is gained to offer insight into methods of policy and sector interaction utilised in a different national context (5.4). Then, fifthly, due to the grounded theory nature of this research, all of the findings from the previous four steps were taken into focus group sessions, with the aim to generate suggestions for future policy pathways within the UK (5.5). These suggestions are reported as the final parts of this results section.

This staged results presentations is designed to address the aim and objectives of the research in a rational manner. The linking of the aim and objectives to the results is presented with table 8:

Table 8: Breakdown of objectives and the different sections of results which address them

Objective	Results presentation
Assessment of the EERS sector and its performance in relation to policy requested sector growth.	Section 5.1: Characterisation of the EERS sector to provide a foundation for understanding sector activity and policy interaction. Section 5.2: Sector performance in relation to policies connected to the sector. Section 5.3: Characteristics of the sector along with performance are assessed in greater depth using group interviews.
Assessment of the performance of the UKs and Germany's EERS sectors, in relation to policy mechanisms required retrofit growth.	Section 5.2: Sector performance in relation to policies connected to the sector. Section 5.3: Characteristics of the sector along with performance are assessed in greater depth using group interviews. Section 5.4: Assessment of the German EERS sector and related experiences, are detailed to provide a comparative exemplar.
Pinpointing of influential factors affecting the performance of policy and the UK's EERS sector.	Section 5.3: Characteristics of the sector along with performance are assessed in greater depth using group interviews. Section 5.4: Assessment of the German EERS sector and related experiences, are detailed to provide a comparative exemplar. Section 5.5: Using section 5.1- 5.4 to inform focus group structures, detailed suggests of possible routes forward for the sector and policy are detailed.

It is an important point that during this chapter a referencing scheme is utilised to ensure increased transparency by making reference to sections of interviews or focus groups made by participants. Within the chapter, the participants role and interview/focus group code will be given alongside quoted data (e.g., R7). To enable the reader to reference sources, table 9 provides respondent number and profession, for additional detail.

Table 9: Participant list

Participant code	Profession	Country of operation
R1	UK national retrofit training provider	UK
R2	Property assessor and advisor	UK
R3	Green Deal installer	UK
R4	Green Deal provider	UK
R5	Scottish Government official	UK
R6	Scottish Local Council Officer	UK
R7	Retrofit training manager	UK
R8	Retrofit supply chain manager	UK
R9	National retrofit best practice coordinator	UK
R10	National builders' merchant manager	UK
R11	Retrofit training provider	UK
R12	Retrofit material supplier	UK
R13	Retrofit installation manager	UK
R14	Retrofit installation business owner	UK
RG1	Retrofit measure installer	Germany
RG2	Retrofit business manager	Germany
RG3	Retrofit product supply manager	Germany
RG4	Insulation product supply buyer	Germany/UK
RG5	Retrofit product exporter	Germany/UK
RG6	Retrofit best practice promoter	Germany
RG7	Retrofit consultant	Germany
RG8	Retrofit building product buyer	Germany/UK
RG9	Retrofit delivery manager	Germany/UK
RG10	Retrofit technology importer	Germany/UK
RG11	Retrofit consultant	Germany
RG12	Retrofit installer	Germany

5.1 The UK EERS sector, details of characteristics and context

This section details the first area of findings within this research and covers the qualitative inquiry into the composition and characteristics of the UK EERS sector, from UK individual interview data. This is carried out to provide a foundation of information as to how the sector is formed, and also provide a starting point to position the research in a place whereby it can address the initial research objective of the ***assessment of the EERS sector and its performance in relation to policy requested sector growth.***

The purpose of this section is not to identify any causal mechanisms that exist between the EERS sector and policy makers, which have contributed to the present level of retrofit activity. This line of enquiry is detailed in the following sections of this thesis. Instead, this section develops an account of the population of the UK EERS sector, to highlight the key aspects which need to be explored when considering the sector, aspects which may need modification if retrofit activity is to be increased. This development of these sector aspects is considered to constitute a crucial step, in order to make better sense of the data generated.

In particular this chapter focuses on different factors which are deemed key in providing detail of how the sector operates. These factors can be considered building blocks for business models. Models which are the manifestation of a business strategy within an operationalised manner, and therefore provide a good foundation to build on, and detail the varying characteristics which make up the EERS sector. These different aspects were emergent from open coding from transcript data, highlighting the key aspects practitioners discussed when asked to speak about the key aspect of their business. These different aspects are summarised within figure 5.

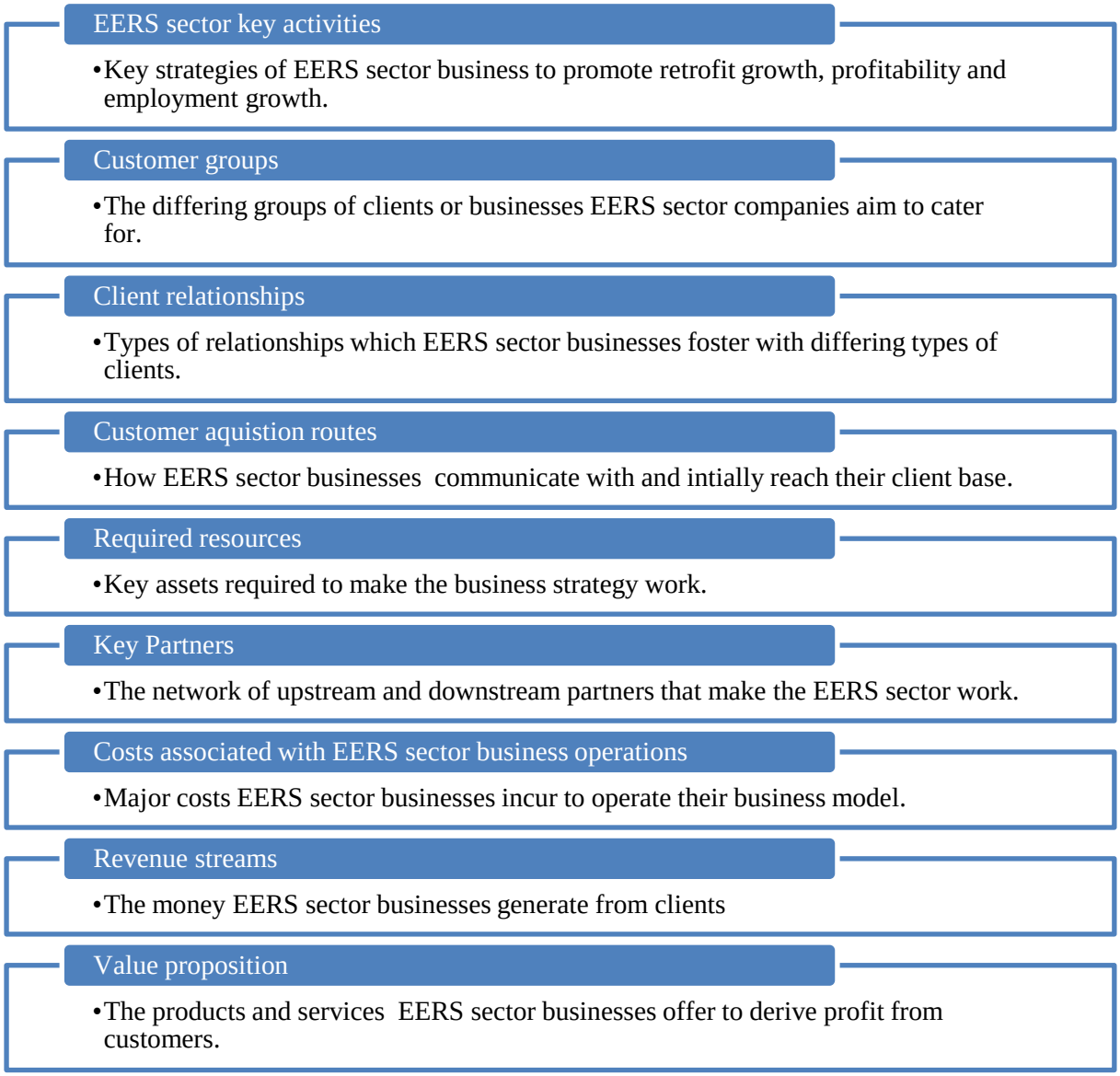

Figure 5: The key aspects constituting an EERS sector business model

5.1.1 EERS sector key activities

Based upon an assessment of the UK participant group of which took part within the individual interviews, two important factors are emergent. Firstly, the participants can be clustered into roughly two groups: individuals involved in a retrofit project directly (assessment, design, install, management), and those who are upstream providing products and business services to the supply chain. This clustering occurred after participants discussed who their key customer markets were. These two groups will be termed *customer centric* and *business centric* within this research. Secondly, EERS sector businesses do not

partake in a standard selection of activities, instead different companies opt to take diverging paths to generate profitable business models.

Within this research, the following breakdown displays (table 10) the way in which the different individual interview contributors have different market offerings. Furthermore, there is a detailing of how the offerings are either aimed at homeowners and tenants (*customer centric*) or have a *business centric* positioning and sell products and services to other businesses.

Table 10: Breakdown of individual UK interview participants and business type

Company type	Number of interviews	Breakdown	Number
Customer Centric	6	Property assessor	1
		Installer	3
		Materials supplier	2
Business Centric	8	Training organisation	3
		Supply chain manager	1
		Retrofit campaigner	1
		Government retrofit supply chain advisor	2
		Local authority supply chain manager	1

What is important to note here, is that although a practitioner may not be first hand installing or interacting with a retrofit project, individuals who are upstream still have a significant exposure to the issues of working with policy and routes undertaken to deal with different policy requirements.

Customer centric

Business strategies which are based on working with customers directly within this research have been identified to fall within two different groups, those which are focused upon deriving trade and profit from policy implementation routes, and those which operate mainly

outside policy implementation routes. Within the policy implementation route, three different routes emerged: single policy measure implementation, multiple measure provision and policy implementation which operates alongside more traditional construction. Questioning areas centred around customer groups, revenue streams and client types, brought forward this information (Appendix A).

This split of the different types of customer centric EERS sector businesses sampled within this research is displayed within figure 6.

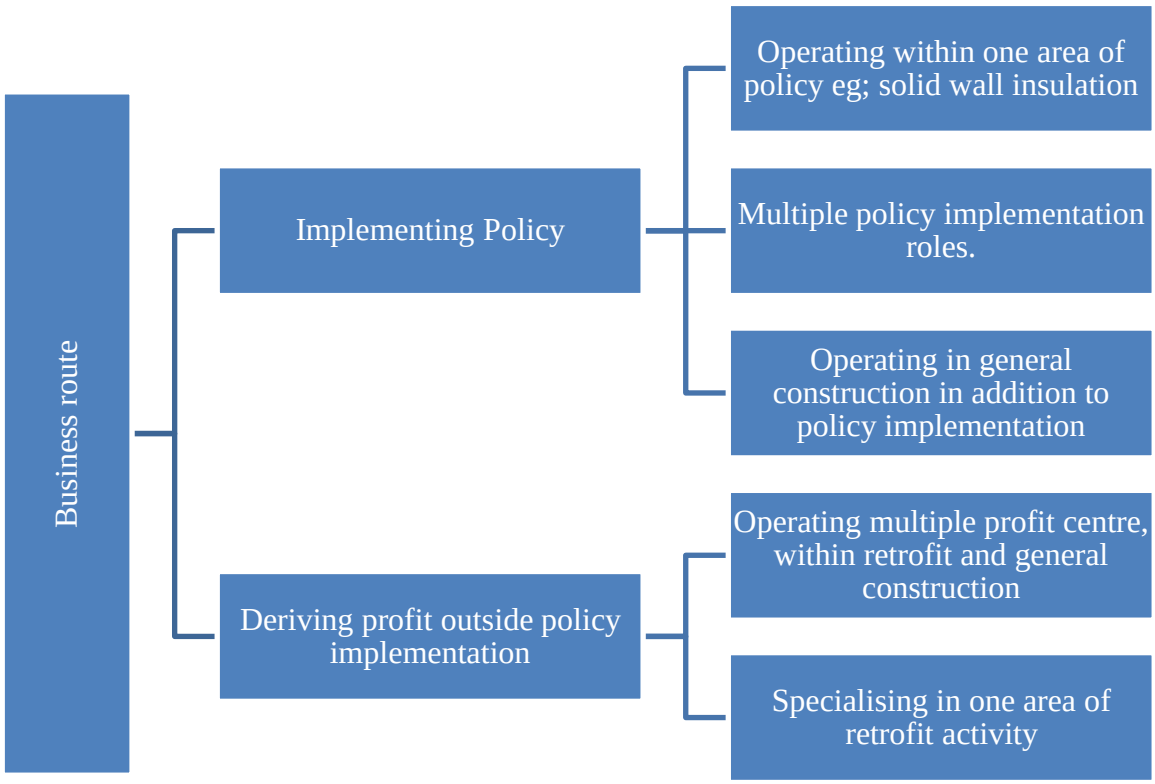

Figure 6: Different customer centric income generation routes.

These five different ways shown by figure 6 in which client centred EERS sector businesses operate, produce a range of different component activities dependent on the strategy chosen. Table 11 takes each strategy, and utilising data generated by open coding of individual interview data, necessary attributes for each route is detailed. Open coding enabled an in depth understanding of the interview transcripts, and therefore also offered a thorough indication of stated business requirements to perform in a profitable manner.

Table 11: Strategies of business appealing directly to end users

Strategy	Requirements
Operating within one area of policy e.g; solid wall insulation	Companies opting to perform in this manner, do so to carry out one area of retrofit activity in an effective and efficient manner, ensuring all resources are constantly utilised. It was stated from interviewed businesses using this method that to enable successful profit generation, certainty was required in market conditions, to ensure high levels of investment can take place to create growth.
Multiple policy implementation roles	Companies opting to derive profit from multiple areas of policy implementation do so to enable an increased level of management from project to project. Supporters of this thinking state that it produces an environment where marketing and project bidding takes up less resources and time. This is due to the increased profit per project, enhanced opportunities to ensure build quality, and also the option to be flexible to client requirements via the use of subcontractors.
Operating in general construction in addition to policy implementation	For a proportion of businesses, opting to retain some of their interests within the general, traditional construction sector, proved to be a suitable method to limit risk and exposure to the policy implementation retrofit industry. This strategy was stated as being popular for those businesses that are locally defined.
Operating multiple profit centre, within retrofit and general construction	In a similar case to those businesses operating in general and policy retrofit construction projects, those businesses that opt to carry out general and retrofit works outside of formal retrofit policy implementation channels. This is done to maximise routes to derive a profit, whilst also limiting overheads with regards to accreditation and marketing.
Specialising in one area of retrofit activity	In a similar way in which policy implementers specialise, business outside policy work also choose to only carry out one area of retrofit activity, in an effort maximise process efficiency via high levels of activity repetition. These business, rely on certainty within operational environments to ensure that reputations can be established.

The value of each of these choices of business strategy is not in question at this descriptive stage of EERS sector characterisation, however later in the chapter (section 5.5.4) when sector optimisation to generate retrofit at scale is consider, further analysis of what route hold the most potential is considered.

Business centric

The other portion of UK individual interviewees involved in this research is positioned within the business services end of the market, a step away from the customer facing roles. These participants offered information as to the condition of the industry and the methods of operation different business adopt. These respondents provide a wider perspective due to their more overarching, geographically widespread activity types. Within this research, the companies operating within this manner do so in the following ways (table 12):

Table 12: Strategies of business centric users within this sample group

Strategy	Requirements
Policy implementation trainers and accreditors	The first area of business service based activity is that of ensuring business are accredited and trained to a sufficient level. Within the EERS sector and also the sample group of this research, these organisations cater for those requiring specific policy accreditation such as GD related certificates, and also more general training and accreditation, such as that for EPC assessment. Trainers and accreditors exist due to the requirement for high quality workmanship within retrofit projects and are needed to bring individuals and businesses up to a level whereby standard outputs are in line with policy requirements.
Building material suppliers	The second group of businesses within the research population operates upstream from customer centric businesses are that of building and retrofit product suppliers. These companies focus on ensuring that product sales levels are high and at a significant volume to ensure unit prices can be kept low via economies of scale. In addition product supply companies wish to keep ahead of the market, or influence trends within the market directly. This strategy thereby ensures that any product offering which they bring to market has a suitably large customer base already established; ensuring the aforementioned scale of sales can be achieved from the outset.
EERS sector network coordinators	The third group of UK business centric participants here are those who are tasked with enabling the EERS sector to work more coherently as a network and provide advance and increased activity via collaboration and knowledge sharing. These networks exist in numerous forms including: paid membership advice, best practice and knowledge sharing organisations, government level departments tasked with advising the EERS sector, and also retrofit installation cooperatives. Within all of these different examples, the network coordinators seek to ensure high levels of quality and best practice by increasing operational efficiency and training levels.

Both customer and business centric groups of practitioners are used here to offer insight into general characteristics of the sector as a whole. It is acknowledged that although the two

groups of respondents are involved in different types of activities, their interactions and insights into how retrofit works on the ground is still deemed valid.

This is of particular note, as the business centric practitioners have more widespread views of the types of customer groups which are going to be retrofit end users for instance. Furthermore, due to the varying extents to which sector businesses operate over different geographical areas, company activities have to be tailored to combat the issue of being limited to a specific geographical area due to resource limitations and small to medium sized enterprise (SME) status.

To combat these limitations respondents stated different routes to ensure that they are able to adopt profitable strategies. These are summed up in the following table (13). Quotes from the respondents are provided in the commentary column.

Table 13: Business strategies for SME EERS sector businesses

Business strategy	Commentary	Number of respondents
Focus on returning customers (private landlords, facilities providers, local authorities), means minimisation of marketing, advertising and travelling expenses.	*'What we have found a sustainable way to ensure the business is maintained and grows, is to keep a network of returning customers of property providers and also developers, so that we don't really have to spend money on advertising, as we have a reliable level of business coming in.'* (R13).	5
Completion of works in adaptable and flexible manner, ensuring all possible projects within close vicinity can be catered for. Limiting travel expenses and marketing duties.	*'We are willing to get involved to one extent or another on basically any project. Where we have promoters out in the local area, we try to provide a full service to any job they get, say with 70 odd miles of the head office, so we have to be ready for lots of different types of jobs.'* (R4).	5
Catering for projects anywhere with the country. This method of operation was stated as particularly suited to business centric companies (6.1.1), where significant growth is needed.	*'We try and cater for all customers anywhere with the UK and Ireland; we believe that as we are providing a wraparound service.' (R12).* *'We provide coverage across all of the UK to ensure that we cater for all possible applicants.' (R11).*	4

These three route show that operating within the sector requires the activity of detailed analysis of the market and the customer groups to ensure that strategies of operation are tailored accordingly. Creating a client base within a bounded area was stated as being difficult to achieve in a highly profitable manner due to the fragmented nature of the different customers looking for works to be completed. Therefore flexibility is a key term which was reoccurring regarding the geographic coverage of businesses. For companies to succeed and

grow, projects which are at distance need to be considered as possible routes of trade and also as methods to boost portfolio profiles, and in turn attract additional income.

5.1.2 Customer groups

The different groups of clients or businesses EERS sector companies aim to cater for

Due to the difference in the perspective of EERS sector businesses operating from within policy and external to it, drivers for customers to commence retrofit projects emerge via different routes. Understanding drivers of these routes offers insight into the customer groups forming the sector's clientele. This section details client type and in addition their varying EERS sector requirements. Resultant from the data is an identification of three types of customer groups: homeowners wishing to live a low carbon lifestyle, individuals wishing to take advantage of policy funds, and large organisations looking to save carbon and money.

Firstly there are households interested in leading an increasingly low carbon lifestyle, and therefore these individuals may approach EERS sector businesses to enquire about possible retrofit measures which may reduce the carbon output of their property. Respondents familiar with these client types suggest that these customers are well versed in the issue of carbon outputs from buildings, and are looking closely at the level of carbon reduction possible. Moreover, due to the fact that in the main these adopters are using their own finances for retrofit, they need to be able to see a sound investment proposition. This requires calculations regarding the level of energy spending which can be reduced and necessitates businesses to offer an in-depth knowledgeable service, as indicated by this statement:

> *'The clients with some money and some knowledge of carbon savings and money savings from retrofit are the ones coming forward to get businesses to do a quality job.'* (R9).

The second area of customer groups participants identified are those who are attempting to utilise government policy to complete a retrofit project without the requirement to have a substantial amount of capital to commence the scheme of works. These customers are inherently looking for an EERS sector business which can lead them through the financing and management of a project to ensure that they are receiving the benefit from partaking in incentive policy schemes. Furthermore, clients of this type need to be confident of business capabilities, and therefore certifications of accreditation regarding the specific policy are

required. This sentiment of working with clients to maximise policy finance benefit is represented by the following quotation:

> *'We have had customers approaching us, I think for most people interested in the policy implementation side of things, who are keen enough, are in it to assess the financial viability of how much money they can get, and how cheap that money will be.'* (R3).

The third area of clients for customer facing EERS sector businesses that emerged from the interviews include those large organisations looking for retrofit action. These organisations can be public entities such as local authorities looking to bundle properties, or indeed private landlords wanting retrofit work to be carried out at a larger scale that an individual property. When scale of retrofit is of importance, it has been stated by participants that high levels of adaptability are required to increase businesses capability to enable the catering of larger schemes of works. Furthermore, with clients such as local authorities, the reputation and accreditation of EERS sector supply chain businesses is key. This concept is demonstrated below, via the statement originating from a retrofit supply chain coordinator operating within local government:

> *'We have a relatively local supply chain capable of carrying out the work, which is fully on board with what we are trying to achieve, they are good at shifting their offering with what we require.*' (R6).

Although these different areas of customer groups show the diversity in types of project and also EERS sector expectation, they also show that for businesses willing to prioritise adaptability and process efficiency, there is the possibility of establishing several rewarding lines of profit generation.

5.1.3Client relationships

Types of relationships which EERS sector businesses foster with different types of clients.

The relationships EERS sector businesses create with their clients is stated as being focused around the provision of quality products and services, which is inherently supported by in depth knowledge and expertise.

This delivery of a quality service has been repeatedly stated as the key way in which the retrofit industry can step away from a perception that the construction industry is characterised as having poor quality, and 'cowboy' outfits trading within it. From this participants commented that an important feature of business/client relationship is that it should include a substantial amount of dialogue between EERS sector individuals and their customers, particularly preceding project commencement. This is stated as important to not simply confirm that the programme of measures is suitable and will meet the expectation of the customers, but to also ensure that plans are well defined enabling an efficient delivery, aiding profit maximisation. In addition, it is stated that the two different parties need to keep in continuous communication to ensure that the varied conditions of the contracts of works are being completed. The high level of customer care is compared to hand holding by the majority of respondents. The following quotation is selected to represent this sentiment.

> *'The journey from initially having interest in retrofit possibilities and actually having your property retrofitted is long and complex, which means that to an extent, companies have to provide a hand holding service to homeowners.'* (R5).

Continuing on from this concept is the fact that installation businesses also spoke of the need to bridge the gap of predicted energy savings from installed measures and actual savings. This bridging is deemed important by respondents as it brings end user expectations in line with reality and the concept that reported savings may differ from in situ savings. This sentiment further galvanises the importance of ensuring that communication and knowledge sharing levels are high, as explained by the following statement:

> *'The issue with the standard assessment is that they only report on predicted energy savings, not actual savings, which leaves the end user with incorrect expectations on the outcome of the retrofit, so it requires the installers to be good at communication and go in and say that in real life the results are going to be different.*' (R3).

5.1.4 Customer acquisition routes

How EERS sector businesses communicate with and initially reach their client base

As identified within figure 5, EERS sector businesses sampled either take part in policy implementation or operate externally to policy. Depending on which category businesses fall into determines the routes taken to acquire customers.

In the case of policy implementation EERS sector companies, door step campaigns, leafleting, newspaper advertising and even televised advertisements have proved the staple of business marketing strategies. These routes are chosen due to their ability to position information in front of potential customers regarding retrofit advantages. Furthermore, these campaigns have been stated to be matched to localised campaigns suiting both the limited geographies of SME companies, and the differences in types of property across the UK. These strategies in comparison to non-policy work also are characterised by high levels of investment from businesses due to the need to see a return on the investment and toploaded projects. This is done to enable full utilisation of the policy fund, as stated by the following statement:

> *'We worked through an entire year doing Green Homes Cashback, right up until March 2014, when it came to a sudden halt, and we pre-empted that was going to happen, so we top-loaded our customer base, 300-400 customers who we have really invested in getting their interest. So we contacted them and got them vouchers for the cashback, before it came to an end, which bought us work through June and July.'* (R4).

When inquiring regarding non-policy implementation EERS sector client acquisition, the participants reported that to enable the establishment of a customer base, simple advertisement is not sufficient to acquire projects. Instead, it is stated that a portfolio of complete retrofit works, accompanied by previous customer positive testimonials is the way to ensure that potential clients are confident in investing in an EERS sector businesses products or services. It is considered that this strategy of letting quality completed work speak for itself is due to businesses stating that due to their small size, quality is better that quantity. Obtaining a handful of project where the clients are willing to work closely with the business to complete a project of great value, was more important than advertising and investing in marketing to generate leads for work of small value. To enable this type of working it was noted that there does need to be an element whereby quality and customer service are prioritised, and also due to the fact that clients are in the main utilising their own finances in this area of the market, high levels of knowledge are required as to the different options of retrofit measures, and schemes of works. This knowledge is required to ensure confidence in the businesses capabilities to utilise personal finance effectively and efficiently, as highlighted by this comment:

> *'I think that the ones who are doing the best jobs are operating outside of the policy areas, working closely with clients in an advisory role, acting on their own completing jobs to a high standard.'* (R8).

Connected to this point, is also the element that customers need to see that investment in business processes is well spent, and therefore internal process efficiency within the business is also important. This produces confidence from the customer, that the business is not overcharging for wastage or inefficiency, and that competition and quoting are on a level with other quality high performing, professional outfits. This portrayal of a highly professional and efficient business appearance is indicated here:

> *'We aim to help to enable businesses to make as maximum profit possible, by ensuring their operation is as streamlined and efficient as possible, we think this is a great way to boost client appreciation that nothing is unutilised, not even their money. It is all about creating an image of capability.'* (R7).

The other area of client acquisition for participants within this research are those companies who trade upstream from end users, business centric organisations who are interested in trading directly with installation and customer facing individuals. In these cases high levels of competition, and also the limited resources of many businesses due to their small size, the factor of a business purchase saving the company money, is a top priority. From this, in the case of training and accreditation businesses, the main strapline to gain trade is to offer a high level of training in how to run a business more efficiently, or how to secure more trade without outlaying significant finance levels for marketing resources. This connects directly to the need for the sectors TCs to be minimised to promote growth. This sentiment is displayed by the following statement:

> *'What has been evident is that businesses working with the Green Deal want to get lean and streamline their operation to be more competitive. So this is where we have come in with innovative software and methods to get processes as efficient as possible.'* (R1).

Therefore, participants reported that the importance is to ensure that a business offering is focused around resource and finance saving for the client. The same can also be said for product suppliers. Not only does the product offering to EERS sector businesses need to be competitive in performance and cost, but it also needs to offer process efficiency to limit

install time. This element is particularly reoccurring within the data, due to the fact that overall retrofit measure installation can be very time consuming because of the tailored nature of each project. This means that an installation requires a significant skill set to achieve a quality result. If a product supplier can offer these elements, and bring a new innovative product to the market directly, at a competitive price, then they have a significant chance of retaining trade. The feature of retaining business was a subject stated by most product suppliers interviewed, as the nature of sales within the industry is completed under tight timescales, meaning purchasers require products, on a next day or even same day basis. Therefore, suppliers need to keep their offering strong across the UK, to ensure potential business is not lost due to stocking issues, or logistical complications. This urgency is indicated by this statement:

> *'With our business being very time critical we have to be able to get our hands on products fast, and if we can't then that is where we have to take the next best option, so I think that alongside the need to innovate, there also needs to be an increase in the provision of suppliers within the supply chain who can bring these new products to the market in a large scale manner, enabling people like myself to get my hands on them exactly when I need them.'* (R13).

5.1.5 Required Resources

> *Key assets required to make the business strategy work.*

One key aspect which was repeated throughout the UK EERS sector interviews was the requirement for adequate capital to alleviate any cash flow problems when providing services for retrofit or commencing and carrying out projects. Due to the majority of the businesses within the sample being classed as SME's, operational capital to continue the cycle of gaining work and completing projects prior to receiving payment, was considered important. Therefore, linked to this is the need for human resources to enable financial management and generate the ongoing trade of businesses, a factor indicated by this statement;

> *'We try and get schedules really tight and get everyone working in as a productive way as they can. I think being a small business it is important to know what you're doing and keep a hold of the cash and monitor cash flow tightly, that way you can protect the fact that you are employing people who rely on you, and you can also protect yourself personally.'* (R13).

Linked to the requirement for knowledgeable human resources with regards to finances, EERS sector businesses also require a wide range of expertise to enable the ongoing survival of a competitive company. Key areas of skills deemed necessary by the respondents include:

- Policy knowledge - to navigate policy, legislative and regulatory frameworks related to retrofit and business operations. This knowledge is also required to minimise the TCs associated with business set up on, including operations contracts with partner businesses or ongoing arrangements with customers regarding works

- Technical knowledge - to carry out assessments of properties and identify the most appropriate route of measures and scheme of works, along with the possible knowledge to be able to bundle projects together to deliver increased per project profits. Furthermore, these skills are required to enable ongoing maintenance and troubleshooting, should the installed measures not function as anticipated.

- Marketing knowledge – to identify clients who fit within the areas of EERS sector operation, and consequently recruit these clients, recognising the exact requirements the customers have.

The skills base therefore is very diverse, with the requirement to grow businesses causing this diversity to increase. Taking a project from its commencement, skills required ranged from: technical specification knowledge to ensure that products and scheme plans are in line with client expectations and have the potential to perform to a high level, to knowledge of correct installation, to business skills to promote EERS sector capabilities. Whatever the specific skill required, respondents stated an awareness of the need to perform to a high standard and surround themselves with a skills base which has the capability to perform operations in a profitable and quality manner, and that there is the potential to generate continued process streamlining and optimisation. This is indicated by the following comments:

> *'In our case, we work with people who I know from experience can complete a job on time and to a good price and level of quality, without cutting corners or scrimping on customer service.'* (R2).

> *'The job is all about creating an organisation which stands for really moral led values, those which are important for building quality, and reliability and trustworthiness.'* (R9).

'Streamlining of business operation and professionalism will mean that companies will be enticed to invest as they will be able to see the margins available.' (R7),

In cases where the skills base within a EERS sector business was insufficient to carry out a project to a suitably high enough standard, there was also a stated trend within the sector of enlisting the assistance of subcontractors to complete part of projects in need of specialist skills, or if timescale or project size requires additional personnel to complete. Subcontractors as a theme were met with one of two reactions from contributors (figure 7). Firstly, due to the trend for EERS sector businesses to be small in size, it was stated that subcontractors provided an economic way in which to provide services and products to projects which would otherwise be out of reach. The second way in which subcontractors are viewed is more negative. Being governed by profit margins, and being squeezed by competition, means that there is the possibility corners are cut, and savings made perhaps where they should not be, detracting from sector reputation levels when a subcontractor is involved.

'We employ 5 people with a base of subcontractors to complete work at high peak periods, which enables us to quote for a variety of project simultaneously.' (R2).

'We have a selection of people and businesses who we bring in, particularly for larger projects, and I know all of them, and know that they are keen to keep their reputation positive.' (R3).

'So many businesses in the supply chain are relatively small; to increase capacity requires subcontractors. The issue with this however, is that there are quality issues, liability issues, and a more complex interaction between client and installer.' (R5).

'I think that the issue we have is that subcontractors are only working to price, they only get work because they are the cheapest, meaning that overall, they are only ever going to try and cut corners and do things for less than stated because that is where extra can be added to the bottom line.' (R7).

Figure 7: Positive and negative statements regarding the value of using sub-contractors in within the EERS sector.

Both of these views of subcontractors show that internally the EERS sector is not as yet able to cater for large scale projects and does not have a significant need to improve human resource levels, to upscale fast to different client requirements.

5.1.6 Key Partners

The network of upstream and downstream partners that make the EERS sector work.

Emergent from the data is the theme that EERS sector businesses typically need a reliable network of contacts to develop a group of acquaintances which can effectively implement energy efficiency measures. Key partnerships were reported to extend throughout the public and private sectors and, in the main were most commonly quoted in the roles detailed in table 14. It is important to note also that EERS sector businesses did adopt very different networks and partnerships dependent on business strategy.

Table 14: Key EERS sector partnerships

Partner	Importance of partnership	Number of participants identifying partner
Sub-contractors	EERS sector businesses regularly sub-contract various parts of their business operations to external parties, normally due to the need for additional capacity and skills located outside the business. *'We are in the opinion that to tackle the issue of sustainable building, we need to take advantage of as many different types of businesses and individuals as possible.'* (R9).	8
Consultants in finance, legal and technical aspects	Knowledge in finance, technical and legal aspects of the delivery of retrofit products and schemes is important to ensure business risk aversion. *'One of the reasons our business has been so successful is that companies are requiring consultants such as ourselves to advise them as to best manage their operations and customer base'* (R7).	6
Retrofit measures product suppliers	The working relationship between sector businesses and material and innovation suppliers is deemed important, as it has the ability to provide sector companies with products at economical prices, knowledge of how to use products, and also access to new innovations. - *We have suppliers of materials which we use regularly. We work on the basis of ensuring that those suppliers know us, so that we can be safe in the knowledge that the gear we are getting is at the right price'* (R14).	4
Other EERS sector businesses	Due to the fact that the majority of business included within the sample here are SMEs, a reoccurring sentiment is the importance to pass business between companies. *'To take on some contracts or even to have some urgency to some jobs, you have to bring in other partners to complete the work. I think that with work sharing overall learning can be generated and progress can be made across the sector.'* (R1).	4

The frequency of the occurrence of the different partners involved within the EERS sector displays that some partners perform a more high profile, central role to business operations than others, and therefore form more integral processes. Within this research the fact that some businesses act as central client points of contact, and other act as periphery partners such as product suppliers or training organisations, means that these partnerships are viewed from both sides of the relationship. The nature of these roles displays that any policy enlisted to attempt to grow retrofit activity needs to be aware that the overall chain of businesses involved within the sector, is widespread.

5.1.7 Costs associated with EERS sector business operations

Major costs EERS sector companies incur to operate their business model

An EERS sector company's most significant costs are detailed by the key activities it carries out to realise a value proposition and the key resources it must utilise to ensure activities are completed to a satisfactory manner. For instance, with regards to retrofit measures installation, EERS sector businesses stated a need to enable a swift professional install, via the employment of tradespeople and individuals with a broad range of skill to guarantee the install is carried out in the correct manner. Alternatively, an EERS sector business may subcontract this work to an external individual. Either route will result in a cost to the business. Therefore, from this it can be appreciated that costs are wide-ranging and differ from business to business. Plus, some costs are associated specifically with the EERS sector, such as property assessments, and others are more generic commerce costs, such as those required to complete financial compliance. Table 15 provides a more complete image of these different types of costs businesses have interaction with.

Table 15: Associated business costs for EERS sector businesses stated by respondents

Associated business costs	Nature of cost
Human resources	Employment of expertise to both design and implement activities which are aimed at improving the efficiency of domestic properties.
Information access	Gathering of information to ensure that products and processes are in place which performs in a manner which is suitable to the property and also the client's finances.
Accreditation	Investment required ensuring that clients and end users are provided with confidence in the performance of the business and the end product which they will be left with.
Operational agreements	Cost associated with generating legal agreements ensuring working partnerships are effective for both parties.
Innovation development costs	Costs linked to the requirement to develop new products and methods of working, including product testing, supply, manufacture and advertisement.
Ongoing operational costs	Ongoing costs include but are not limited to; rent, utilities, transportation, insurances, memberships, training, and taxation.

It is also worth noting here that in reference to section 5.1.1 whereby the sampled businesses were split into customer and business centric groups means that there are different costs associated with the two groups. Customer centric operations, encountered costs associated in running a business operating on individual projects and costs linked to running a SME. Business centric companies in this sample and more heavily linked to costs associated with operational agreements for the supply of services for instance, or innovation development costs for new emergent products.

5.1.8 Revenue streams

The money EERS sector businesses generate from clients

As reported by participants, an EERS sector company's central revenue streams are dependent upon the extent of its involvement within a project. In the most extreme cases, a

business which chooses to only cater for one aspect, could be involved within a project and derive revenue from a short period of insulation installation for instance. At the other end of the scale, a business may choose to work within a project at numerous stages, generating multiple profit centres. These different profit generation routes can include the initial assessment of the property, design of the scheme of works, sources of products and materials, installation and ongoing maintenance. This variety in methods of profit generation is typified by this statement;

> *'Overall we have maybe 6 or 7 areas of activity, training, energy rating solutions, inventory programmes and also energy rating consultancy.'* (R1).

In a similar manner to the ways in which different businesses choose different routes to combat geographic boundaries limiting trade, other companies look to pursue multiple profit centres within one project and therefore limit the amount of time and resources spent gaining different jobs. Supporters of this method comment on the way in which it permits the development of a good working relationship with the client due to the extended exchanges between parties, plus there is the factor that it promotes an increase in the skill set of the people working on the project, due to the problem solving skills required to carry out different task which are interwoven. Via this increased level of skills within businesses, risk is mitigated against by the notion that the company can work on projects of different natures, as shown by this statement:

> *'We needed to create some additional lines of income generation, for risk aversion really, just to stop all our eggs from being in one basket.'* (R2).

5.1.9 Value Proposition

> *The offering of products and services EERS sector businesses offer that appeal to their customers*

The most important factor of an EERS's value proposition is that they are able to cater for a customer's energy efficiency needs (e.g. power, warmth, carbon saving, energy saving, finance saving). Critically, EERS sector businesses seek to achieve this via a lowering of a property's power demand, thereby offering a value proposition to a client. In the main, this is achieved via the installation of energy efficient technologies, or passive material measures which reduce the property's draw on energy.

In the case of the sample here, customer centric sector business seeks also to ensure that their value proposition is a quality service and provision of products to the end user. Business centric companies look to generate a returning number of customers via the provision of service or products which are highly competitive in terms of price and service, and also which are delivered in a manner which is professional and contributory to a positive reputation. This sentiment is shown by the following comment:

> *'We have taken an active stance to not really market our products and services heavily, and have instead taken the option to carry out specific marketing opportunities which permit the preservation of the quality image we are trying to portray in everything we do.'* (R12).

5.2 EERS Sector Policy Interactions

Taking the previous subsections of this chapter into account, and the different characteristics of the EERS sector, the following table 16 and figure 8, offer an overview of areas, which have been identified as positive and negative aspects of the way in which the sector has progressed. The section then continues to breakdown further the interactions between the sector and policy.

Table 16: Advancements and successful strategies of policy/EERS sector relationships to date

Area of progress	Description
Increased levels of quality	Higher quality schemes of work, completed to a deeper retrofit level, have been seen to be more prevalent. These projects, although not high in number, have been stated to be influencing the way in which the sector operates as a whole. Also, it details the way in which the sector can access clients with larger sums of capital, who are willing to pay for high quality retrofit projects, and in turn provide a finished product which is up to standard, as suggested here; *'We are fortunately at that end of the market, whereby people have a bit of money and understand it, so we have had to opportunity to lead some great retrofit projects and work closely with the client.'* (R8).
Increase in Passive House standard properties	It was commented by numerous respondents that within the higher end of the sector, clients are progressing retrofit levels towards passive standards (high energy efficiency level, meaning little energy required for heating or cooling). This displays that not only are some end users aware of the possibilities of what expertise and products can accomplish, but also that they are willing to commit finance to projects to complete them to this level. *'The passivhaus market in the UK is still niche, but it is doubling in size every year.'* (RG5). *'The fact that we work towards an increase in the level of passive house construction within the UK. We are passionate about enabling more of these types of building, due to its high performance, and also its ability to progress the level of economic and employment growth within the UK.'*(RG9).
High performance projects encourage innovation	High performance projects at the higher cost end of the sector, has also been the area encouraging product suppliers to increase their product roster to attract business. *'One stream which has increased over the past few years since around 2008 is that of our sustainable materials range, which includes efficient insulation, natural insulation and other recycled goods. Since the crash we have struggled to keep other products at a continuous level whereas the sustainable area has grown.'* (R10).

From these points regarding the positive performance of the EERS sector, it is evident that overall the sector has the capability to provide high quality schemes of works to end users who have the inclination to invest in retrofit works. What is missing however from this situation is that these high cost, high performance projects are yet to be applied at a large scale, particularly alongside government incentive schemes. Using memos and theoretical coding, the reasoning for this may be due to the stated following negative aspects of the sector (figure 8). This flow of ideas is a consolidation of different ideas into a connected diagram highlighting possible links between factors hindering retrofit progress.

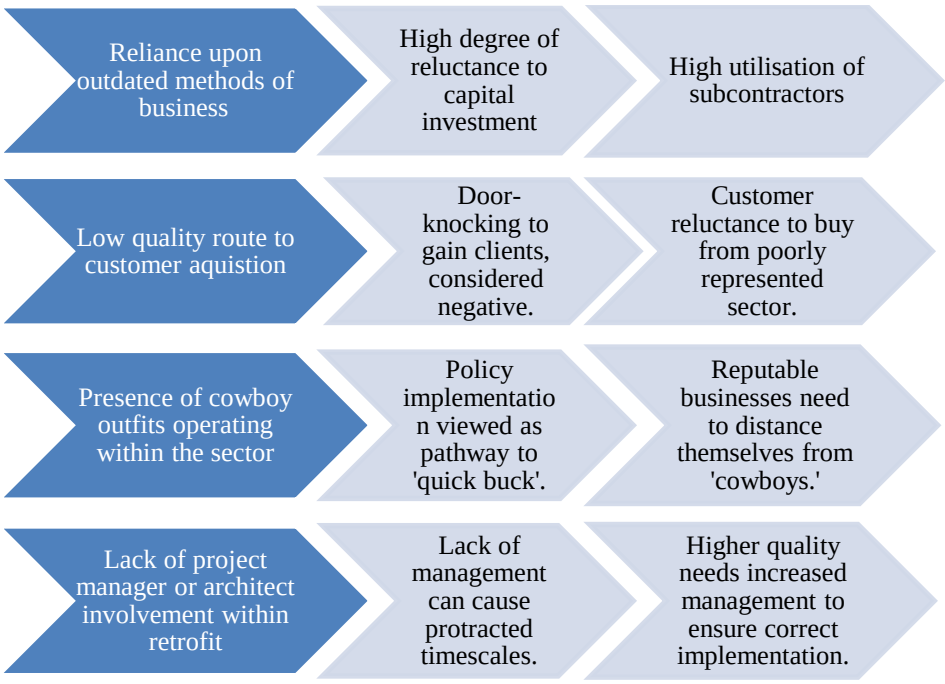

Figure 8: Aspects of policy/ sector interactions which are hindering retrofit activity increase.

Taking the areas which should be built upon, and also the areas which need to be altered (table 16), the following sub-sections detail at a greater level, the way in which the sector has interacted with policy. The purpose of highlighting these concepts which relate the EERS sector and policy is to enable an appreciation of what aspects of policy, practitioners are talking about most, in terms of running a successful EERS sector business. This includes: the way in which policy is delivered, the formation of the sector and its ability to deal with policy schemes, business tactics to maximise the competitive advantage policy implementation offers, and the way in which policy impacts overall market conditions. All of these themes emerged from theoretical coding of individual interview data and the establishment of memos

representing coded data (section 4.8.3). The breakdown of these memos informing theme creation is set out below in table 17:

Table 17: Overarching themes emergent from individual interviews, and codes which informed them

Themes	Memos emergent from open coding
Policy Delivery: ***Policy design and administration, impacts upon the EERS sector. (Section 5.2.1)***	-Differential between sector and policy expectations plus aims. -Divergence between policy and sector timescales. -Issue of insufficient finance, and high interest rates. -High level of due diligence required from businesses. -GD online databases and information outdated. -Innovation not efficiently incorporated. -Divergence between urban and rural retrofit provision.
Delivery chain formation: ***EERS sector delivery strategies for growth. (Section 5.2.2)***	-Move towards integrated delivery chains required. -Increased levels of communication and dialogue between parties needed. -Strategy of taking advantage of multiple profit centres. -Requirement to work in a way where companies of all sizes can trade. -Increased levels of certainty needed from policy and income sources.
EERS sector policy utilization: ***Strategies to maximise economic impact of policy. (Section 5.2.3)***	-Accreditation and process compliance as routes for growth. -High level of profit margins needed for competitive policy implementation. -Utilisation of cash back as a method of policy implementation. -Lead generation and customer care key ways to enable trade growth. -Adaptability and flexibility required to respond to policy changes.
Market conditions and policy: ***Barriers provided by market environments to retrofit growth. Section (5.2.4)***	-Issues of stop start nature of funding from policy incentive origins. -Constricted placement of EERS sector between customers and policy. -Lack of certainty of market conditions limits ability to plan strategically. -Finance provision insufficient from policy, meaning customer contributions needed along with high street interest rates for borrowed money. -Limited flexibility within the types of measures within policy rosters.

5.2.1 Policy Delivery

Policy design and administration, impacts upon the EERS sector

Without exception contributors spoke of concern for the fact that due to a divide between the ways in which policymakers and EERS sector practitioners operate there is an inhibiting of change. Participants stated that this divergence has the effect that different parties operating to implement policy feel as if they are taking on greater risk than others. This means businesses are utilising risk aversion tactics such as limiting resources focused on growth, investment and innovation. This concept is detailed by this related statement:

> *'At present there is too little focus from policy makers in positioning schemes in a permanent way. Without this certainty, all that will happen is that the goal post will continually change and businesses will be even more deterred from engaging with the policy and investing.'* (R9).

The majority of respondents stated that with the market reliant upon government and Energy Company funding there is doubt from practitioners as to the actual availability of finance, particularly to SMEs. The issue of accessibility to funding from the cash back scheme was stated to be prevalent in the way that, to discourage a rush to take advantage of the finance before it closes, the incentive streams are closed without warning leaving businesses uncertain at all times as to the opportunities available to them. Therefore, the issue of the principal agent problem is prevalent, with businesses reluctant to become involved and invest in an industry where government agencies are perceived to be calling the shots, to their own ends. This mistrust between parties is indicated by this statement:

> *'The figures EST Scotland released in March 2014 showed that they had not used all the funding for the Green Homes Cashback. They hadn't exhausted the different pots of money that they had allocated. But they chose to close it off. I would love to know the reasoning for that.'* (R4).

In addition to the unsuitability of policy formats for businesses, the majority of interviewees also stated that the high amount of due diligence and compliance required to gain access to the funding, meant businesses felt policy administrators have made it as hard as possible for

finance to be accessed. It was suggested that the level of paper work and 'box ticking' involved in the process of ensuring money was gained for work completed under the GD and ECO, was excessive. This high level of administration was stated as a key reason for many businesses entering into the delivery of policy and then not continuing the provision. In fact it was suggested by one respondent that the online database the *Green Deal* Oversight and Registration Body (GD ORB), listing all businesses involved in GD delivery, was full of businesses that are no longer trading:

> *'With the Green Deal ORB database, loads of standard businesses set up on there to make a quick buck, and when they realised that actually to deliver they had to dedicate resources they soon lost interest and either went out of business or resorted back to the standard work of only doing jobs which require the least amount of commitment.'* (R2).

This phenomenon of high resource demands from policy compliance also was believed to cause high numbers of SMEs to be rejected from the market, due to their inability to complete with larger outfits. The majority of individuals from smaller businesses stated that they felt unable to compete for large installation contracts such as those for housing associations, due to a belief that there is a trend for these business opportunities to be offered solely to larger businesses. This issue is exacerbated by the factor that within smaller companies, the skill base to enable tender competition and extensive successful marketing is limited. This mismatch between sector optimisation and reality is characterised here:

> *'It was predicted that smaller operations could compete on a level playing field with larger outfits to gain work via consortiums and such like, but as ever what has happened is a trend for larger jobs to been given directly to large businesses.'* (R5).

Respondents who operate away from urban centres also spoke of the factor that the policy structure did not offer incentives for businesses to operate across rural areas, who may encounter higher costs due to the extended geography of services and customers. This means that householders in properties away from urban centres may have been without access to a business offering GD services. It was also considered that more rural locales were the environs of SMEs due to larger businesses viewing these environs as troublesome, when attempting to create economies of scale for retrofit projects. SMEs therefore felt that the bias

was not weighed in their favour, even though in the main retrofit schemes are suited to small operations due to the high level of service and product tailoring to complete projects. This absence of rural sector ability is indicated here:

> *'A lack of SME competitivity is in some areas drastic, as in the main Green Deal installers have been family run or smaller sized outfits, meaning for lots of regions gaining a like for like quote, or standard of service is hard, when comparing rural to urban areas for example.'* (R5).

Policy making timescales were also areas where issues were presented to EERS sector businesses. It was considered by the majority of respondents that the timescales within which policymakers operate was too short when compared to the standard timescales of businesses looking to invest, grow and see returns. Therefore, this difference in operating discourses resulted in EERS sector businesses being reluctant to put financial capital into operations, without some kind of guarantee that market and policy conditions would remain stable at least a decade. This short term uncertainty of policy for business conditions is displayed here:

> *'Commercially for us as with many other businesses, we have taken a stance that the short term nature of policy is simply not compatible for our business model and projections.'* (R10).

From a more positive perspective however, table 18 shows areas in which policy did succeed in delivery. This shows that policy has provided some improvements to EERS sector operations, but also indicates that policy learning can still occur to enabled optimisation and the eradication of the negative aspects of policy detailed within this section.

Table 18: Positive operational capabilities of the present EERS sector.

Positive aspect of delivery	Respondent statement
Prioritisation of EERS sector business accreditation proved to be a constructive method of improving the approachability of the sector for end users.	*'With the accreditation, in my experience, the install guys are great, and the customer focus is great. So the policy is producing customer focus.'* (R4).
Approval of assessments, as they not only offer a method of evaluating properties equally, but also providing a method of tackling the issue of behavioural change.	*'Considering the complexity of a building, and the different impacts of the actual building and occupants, I think the Standard Assessment Procedure (SAP) is the most suitable method, considering the level of time and money which can be dedicated to a singular building.'* (R1).
Policy connects the end user to an organisation which can lead them through the process and provide a method of linking GD and ECO offerings with other businesses such as renewable providers.	*'There has also been some network linking and getting renewable providers to work on retrofit projects. This is a great step forward as it means that there is the development of a one stop shop for homeowners to enable the creation of a deep retrofitted property.'* (R5).

5.2.2 Delivery chain formation

EERS sector retrofit delivery strategies for growth

Energy efficiency retrofitting represents a significant challenge for an industry where a large increase in capacity is required. Therefore the trends identified from the data indicated that there is a need for an increase of joined up and integrated delivery chains, comprised of increased levels of communication and also improved distribution of responsibility and risk.

At this point where the EERS sector is still in its growth stages, many businesses completing low carbon retrofit work under government schemes, are doing so whilst also running more mainstream construction or facilities management organisations. This attitude to carry out multiple profit generation routes is indicated by the following statements:

> *'I was looking to expand our operations and create some additional lines of income generation, for risk aversion really, just to stop all our eggs from being in one basket, it didn't really require much alteration to our business model, so it was a no brainer really.'* (R2).

> *'We do operate with a whole host of other companies who carry out other work to do with traditional refurb, but what I would say is that we are in the game of landing maintenance contracts, so we have sole control of a project, and complete multiple different roles, which limits our risk.'* (R14).

Practitioners within these businesses also stated a requirement for delivery chains to be inclusive and provide opportunities for all different types of businesses, including SMEs and self-employed individuals. This issue of SMEs being out-competed due to delivery chain formation is highlighted here:

> *'There have been reported issues the high compliance costs to meet the due diligence required to get finance from the energy company, has meant smaller businesses have been less active in the delivery chain. They do not have the resources to complete the level of due diligence. The issue of SMEs being out competed is also clear with housing associations as the large scale of the jobs in general is out of reach for all but a handful of installers.'* (R5).

Furthermore, with businesses that are operating in both mainstream construction areas and the EERS sector, certainty is required from the types of income available from policy lead schemes. This is considered key for forward planning, and for the risk of being exposed to one market minimised. Present concern with short policy scheme periods is indicated via this comment:

'With a short election period governing the way in which policies are managed, means that there is a disagreement between business who want to operate on a 10 years period, to enable thorough planning and drawing up operating contracts and procedures, and government who want change within 12 months sometimes.' (R5).

5.2.3 EERS sector policy utilisation

Strategies to maximise economic impact of policy

When asked about strategies to maximise economic impact of policy, the majority of respondents stated that both the GD and ECO are unprecedented in the demands they place upon EERS sector practitioners, therefore the roles of low carbon retrofit business individuals have evolved. Initially accreditation and process compliance had to be an area whereby companies needed to increase awareness and knowledge, along with detailed understanding of how profit margins could be generated by implementing policy.

One area identified by the majority respondents operating within policy delivery, as a method of ensuring work levels, is to take advantage of cash back and government financed funds.

'We became accredited in March 2012, and started looking for different channels of income, and by June, we realised that the Energy Saving Trust Scotland was advertising the Green Homes Cashback Scheme. Therefore, we decided that the scheme would be a good avenue of income generation. So that is what gave us a kick start.' (R4).

In taking this route however, respondents stated a need to become adept at lead generation and cash back administration. As many cash back eligible households are within priority groups, where levels of computer literacy can be lower than average, the administration of the scheme was stated as an area where significant resources had to be dedicated. This application of resources to gain cashback work is indicated by these statements:

'I think the lack of clarity to the end user is a major barrier. The journey from initially having interest in the policy and actually having your property retrofitted in a long and complex process with numerous different actors and stakeholders involved. This complexity means that to an extent, in the past, companies have had to provide a

hand holding services to homeowners, which is of course resource intensive and a drain on limited resource companies.' (R5).

'Our customers really came through that scheme, most were entirely unaware they were eligible for the cashback and thought that it was for people on benefits for instance, they didn't realise it was open for all. So we spent most of our time explaining that they could have it, and gained our customer base from that.' (R5).

Furthermore, in utilising cash back incentives to gain work, businesses stated a need to ensure they had an ability to soak up levels of high and low work periods. This is due tranches of funding being cut off at short notice, meaning for many businesses who were able to pre-empt this change, work could be top-loaded or resources channeled to different areas of the business structure. This feeling of uncertainty regarding the policy discourse is stated by this interview sample:

'The present system as it stands today, I would say does need some work to make sure levels of business is growing at a sustainable rate, because at the moment we have to deal with all the uncertainty that the policies have.' (R13).

Feedback from policy delivery practitioners also covered the fact that policies such as ECO and the GD did effectively create a sector which is entirely focused upon the end user. This means that administration channels are tailored to different types of customer, trade peoples on site are considerate and compliant with procedures, and after sales care is high. This effect is increased by the fact that many business operate at a local level alone, meaning both managers and employees are members of the community in which they operate, adding to the need to provide a considerate service. This concept is indicated by this statement regarding the interest level associated with the GD loan:

'To be honest, it needs to be attractive for the Green Deal assessor to sell. Everyone has their own moral code and for us it stops at 5%. We live and work locally, we need to retain a good reputation.' (R4).

5.2.4 Market conditions and policy

Barriers provided by market environments to retrofit growth.

The concept of forward planning and positioning businesses to enable growth into the future was also a theme evident within the majority of interviews. Individuals stated that due to the ways in which the GD and ECO is administered, the cash back incentives are seen as the best way to gain clients by businesses mainly, due to the unattractiveness of the interest rates attached to unsubsidized finance packages. This however was also believed to create market conditions where activity within the industry is stop start, with funding for cash back schemes uncertain over extended time periods. This concept of uncertainty is indicated by this statement:

> *'There was the early adopter Cashback fund which attracted a lot of interest from end users, which was positive for supply chain companies, but at the end of the day, all it meant was the retrofit businesses had to soak up the extra demand by enlisting third party companies to carry out the work, and then once the tranche of funding had run out, everything went back to the way it was before, not something I think the policy makers had in mind.'* (R11).

The majority of practitioners also spoke of the constricted nature they felt acting between end users who were trying to take advantage of the finance incentives, and the fact that policy administrators where not wanting top loading of cash back fund applications, and therefore switching the finance stream off without any prior notice. This feeling of distrust is exemplified with this comment:

> *'I can see that some of these schemes are merely photo opportunities for politicians to say they are investing a certain amount into Scottish homes, but the key thing is that they make it as difficult as possible so that it cannot be spent. They get the full plaudits for trying to make a difference, but if they can keep the money then it is a double win.'* (R4).

This lack of certainty in market conditions means that businesses stated an inability to strategically plan ahead or indeed utilise resources innovatively and create streamlined operation approaches. In practice, taking advantage of government fund offers was stated as

comparable to boom or bust business operations, and whenever finance was available all resources were channeled, to applying on behalf of customers for the incentive. This method of operation creates a market where companies are minimising overheads and utilising different sub-contracting businesses to complete works (used by the majority of respondents to some extent). This in turn reduces the quality of customer journey. This lack of certainty driving business decisions are shown here:

> *'I think for any new or developing business in a competitive market, you really need to steer away from taking on too much risk. If you don't know the kind of levels of trade into the future, the correct thing to do is to have minimal overheads to carry yourself through dry periods. So as far as reasons go for the way in which businesses have operated since the Green Deal started, definitely the main things that has impacted every decision is the lack of certainty in the way the policy is impacting the trading environment*.' (R11).

Furthermore, an area which was a reoccurring trend within all practitioner interviews was that of the financial structure of the GD and ECO. This produces numerous different areas of concern, as detailed within figure 9:

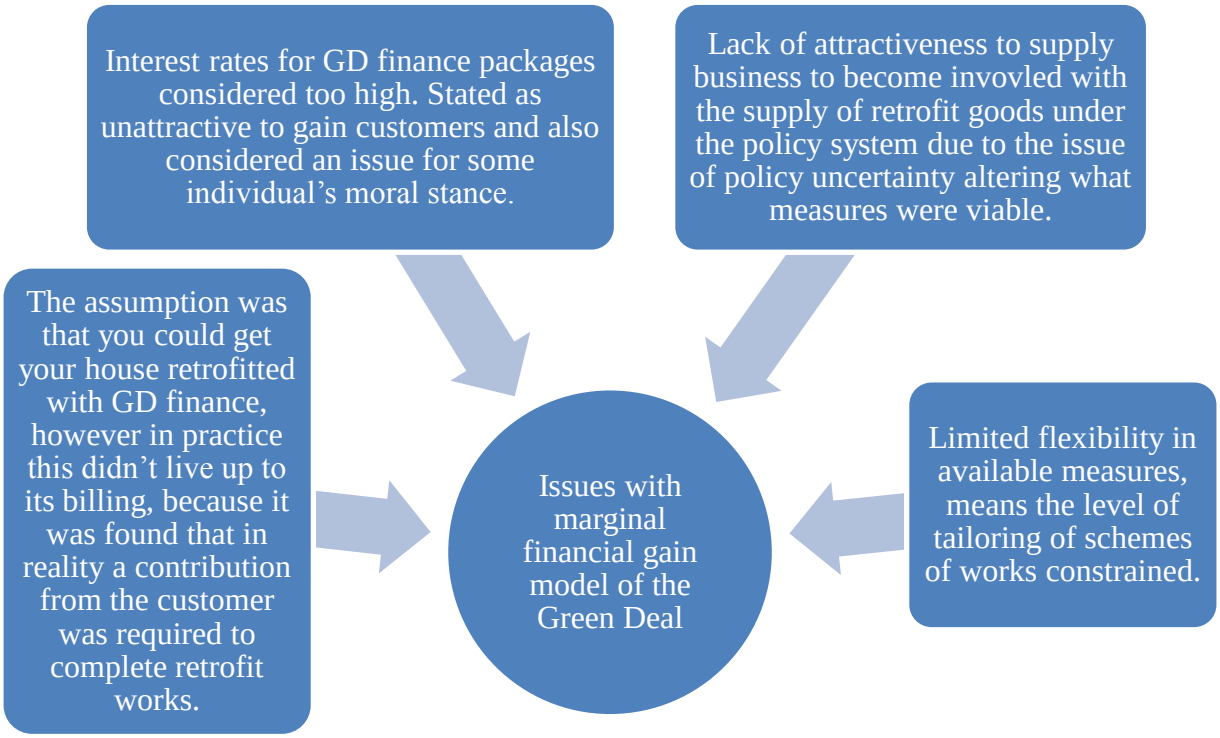

Figure 9: Issues with marginal financial gain model of the GD.

Therefore, from this assessment of the financial provision within the GD, this issue of a lack of sufficient funds to completely cover a scheme of works, along with unattractive interest rates, and limited to attract quality EERS sector businesses into policy implementation, left the GD with a significant gap between predicted outcomes and actual performance.

Overall, the findings from the individual interviews show that the relationship between the EERS sector and policy is very complex, and made even more complex by the fact that high levels of diversity within the sector means the characteristics of each commercial operation, is very different. To enable increased insight and accuracy of this sector assessment therefore, the findings from these interviews will now be further assessed within the group interview stage.

5.3 German individual interview findings

Remaining within the Grounded Theory nature of this research, the findings from the UK were utilised as a foundation, to determine how the EERS sector within Germany is or is not experiencing similar concepts within their nation. The aim of this step is to provide scope for learning as to why a difference has occurred and what lessons can be learnt from working in an alternative way. In total 12 German semi-structured individual interviews took place, lasting between 25 and 60 minutes. All interviews of this type took place over the phone and were conducted to ensure ease for the respondent to partake in the research.

5.3.1 Key differences between the nations

Similar to UK data collection, questioning within the German interviews focused around EERS sector practitioner experience in attempting to work with policy and increase the level of retrofit activity. From this the following aspects have been identified as divergent to the way in which the UK operates. Due to the UK's volume of energy efficient activity being behind Germany's, this step is considered important to identify what should or should not be focused in on, as an aspect to change about the policy/sector situation within the UK.

The first difference identified is that of product supply businesses being in the main determined by buying groups, limiting the role of smaller businesses.

> Resultant from the trend of German building product buying groups is that for product prices to be more even, meaning that the larger companies can supply products competitively against others. Plus they can also bring innovations to market at a

competitive price, due to the large volumes. This process is stated as being simpler due to the low number of stakeholders involved in the process; the number usually being limited to the inventor or supplier, the buyer and the representatives for the point of sales. Furthermore, due to operators in Germany, having access to relatively larger amounts of people and businesses completing retrofit works, this launching of innovations can be completed in a much more efficient manner. These differences from the UK show that the overall delivery of retrofit products and innovations is completed in a much more streamlined way.

Secondly German interviewees stated that in their opinion, the level of deeper retrofit schemes was deemed more prevalent within Germany than the UK.

The level of depth at which retrofit schemes are carried out within Germany is deemed by practitioners to be higher than that of the UK. The following reasons were stated as drivers for this:

- Due to a prevalence of time served trades people, increased problem solving and complexity of installation can occur on site, which in turn can result in deeper retrofit levels.

- Culturally, it is considered that members of the public have a greater awareness of what improvements could be made to properties and what innovations are on the market. Thereby there is a greater level of collaborative working between clients and EERS sector professionals to deliver a high performing, tailored project.

Finance provision also permits increased depth in retrofit due to the flexibility in the level of funds available and also the ways in which the funds can be spent. This level of tailoring means that end users can customise their retrofit in many different ways, and therefore can undertake a deep retrofit should they so wish.

The third area stated as different between the UK and Germany, is the level of awareness of low carbon and energy efficient living amongst members of the public.

Linked to the previous point, the consideration amongst German participants was that members of the public culturally have an embedded higher awareness of the importance of living a low carbon lifestyle. In many cases this increased awareness presents itself as a direct involvement with the design and specification of project by the clients, and an enthusiasm to maximise the performance of a scheme of works.

This involvement in turn means that new products can be effectively integrated into the market, and placed within a project which is not always entirely cost driven, but driven by a desire for future proofing. This is believed to be the key driver in the significant number of Passive House standard properties within Germany. Product marketing is also different between the nations. Within Germany the increased knowledge of the concepts surrounding retrofit, mean that products are stated to be supported by significant levels of performance data within marketing material, in comparison to the UK. This sentiment is displayed by the following statement;

'Well to be honest in the UK we actually do very little marketing work, because overall we have found that house builders in general are simply working to price and to the minimum standard they can get away with. In the case of Germany, the whole housing industry is completely different; there are major house builders in the UK who are only interested in price. In contrast to Germany, in the UK buyers are not really interested in the quality of efficiency of house; they are more bothered about the location, the kitchens, the bathrooms, the sizes of the rooms etc. There are also only a very small number of people bothered about low carbon buildings. That then leads onto the fact that for builders, there is no real additional revenue to be made out of making something Passivhaus.' (RG10- Passive house product importer).

The fourth area of consideration by German interviewees as a concept which differs between nations is that of the level of streamlining generated by using networks.

Due to an expectation to deliver a high level of quality in an efficient manner within Germany, participants considered being within an effective network as very important. These networks are deemed advantageous for the following reasons:

- When searching for new products or ideas, networks with professional experience can act as a source of extensive information, which is grounded within live projects.
- Networks offer the opportunity to share work and projects, enabling periods of minimal work to be filled with additional projects. This can be of particular importance when the network involves members who operate at design or project management level, when trade can be passed down to install practitioners, removing the need for client acquisition.

- Operating within a network permits practitioners to operate alongside other trades who are operating at a similar level of quality, thereby ensuring that projects are completed with all contributors working towards a similar aim.

  Networks also mean that different types of tasks associated with retrofit can be completed by the most suitable tradesperson, ensuring maximum quality for the end user, as well as confidence in the fact that all components will operate together effectively.

The rate of innovation development is the fifth area, whereby different rates of progress were stated to be being made between Germany and the UK.

It is considered that within Germany levels of innovation and development occur at a higher rate that within the UK. This belief was formed due to the following reasons:

- The higher volume of projects being completed within Germany suggests that businesses invest more in bringing new products and processes to the market, due to large returns available.

- Prevalence of deeper retrofit projects means increased levels of onsite problem solving by individuals with high levels of expertise occurs, which pulls new innovations forward.

- Perceived conservative nature of the UK's construction industry in general means that businesses deem innovations are not met with such open acceptance, when compared with Germany.

- On site problem solving considered prevalent within Germany, meaning that innovative practices can occur which are reactive to problems. This method of working means that new processes and technologies can be brought forward without the concern for simply the economics of a problem, as is the way with larger businesses. Furthermore, the specific nature of this problem solving means that innovations are not broad brush but instead are tailored to particular properties and issues.

German retrofit loan systems, particularly the public KfW finance scheme permits homeowners a significant level of finance to complete retrofit activities to deep levels, meaning that innovation needs to be brought through the supply chain to satisfy this demand.

The concept of prioritising a streamlined and efficient method of completing projects is the next area considered divergent between the countries. Ensuring process efficiency is considered a high priority within the German EERS sector. This is considered the case due to the following reasons:

- Minimal reliance on sub-contractors strategised as a key way in which to streamline operations within EERS sector businesses due to the absence of administration costs when managing external resources, and also the reduction in delays when awaiting third parties to attend to the project.

- Increased customer satisfaction was stated when a business is able to deliver a project within a compact timescale where processes and components are brought together in a timely manner. This strategy involves project management and business administration skills to ensure that process efficiency is achieved. This limiting of project timeframes is indicated by the following statements:

  'More retrofit projects could be completed if people were aware of exactly how long the project is going to take, and even better if it can be completed in less than say 2-3 weeks. So yes we are moving in the right direction, but we still need to make it to a point whereby all people are working together in a really time efficient manner.' (RG1- German retrofit installer).

  'I think what is probably needed is more of a focused look at the delivery of retrofit project, I think that the case in Germany and also I guess the case in the UK is that some projects are not even started because people are too reluctant to deal with the disruption of people being in their home for extended periods. So if there was more of a focus on putting together a delivery team whereby even a deep retrofit could be completed swiftly with all trades working together, then that would be a big step forward to getting more retrofit completed.' (RG7- Retrofit supply manager).

- High levels of process efficiency considered only possible when tradespeople are brought in with significant levels of skills and expertise to ensure problems on site do not protract project timings. This route is considered a method to keep project costs down, and even though skilled practitioners cost more in the short term, the quality offered is considered important and worth the increased outlay.

Process efficiency in itself is a carbon saving practice due to the minimisation in carbon emissions, thereby ensuring that retrofit activities themselves are conducted in the most sustainable manner.

The next area highlighted within the German interviews, is that the level of customer service prioritisation within Germany is considered higher.

This customer service emphasis is detailed by the following concepts emergent from the data:

- High levels of expertise amongst practitioners and related time served experience means knowledge dissemination to clients is at a high level, meaning participants stated clients feel informed by the information they are receiving. Furthermore, this on site expertise via time served trades people creates a high tailoring of projects, increasing the level of project satisfaction experienced by the client.
- Linked to the previous point is also that high levels of expertise means there is a limited requirement of specialist sub-contractors who may cause project timescales to become protracted.
- The rate at which products are brought to market within Germany means that the products and materials can be brought to site quickly, generating low customer lead times, increasing the level of service delivered.

Customer service also built into the German market due to a perceived higher level of expectation from customers that the project installation, performance and end project must be to a very high quality.

Following on from the previous point is the fact that the availability of high levels of customer finance is another area in which Germany out performs the UK.

Due to restrictions in finance availability being one key reason why UK home owners are reluctant to undertake retrofit schemes, German participants stated a belief that within Germany finance levels are higher, enticing more end users to carry out higher levels of retrofit. The following are key aspects of this concept emergent from the interview data:

- Increased borrowing is stated to allow added development of retrofit products and technology, as indicated by the following statement:

  'In Germany, if you so wish you can borrow at a very preferable rate a very large amount of money and the sky really is the limit. So from that perspective, the policies and funding mechanisms in place really do permit the industry to grow, because there is so much room in the demand. You could have people asking for renewables, underfloor insulation and airtightness membranes all in the same job, which means suppliers, are onto a winner as there is always demand.' (RG2- German product exporter and installer).

- Low interest rates associated with German finance means members of the public are more likely to apply for larger sums to complete more ambitious projects, which in turn aid the increased level of carbon savings.

  Finance is not limited to specific materials or technology meaning there is an increased likelihood that a wider variety of products and incoming innovations will receive the benefit or being included in a scheme of works.

The next area identified of significant difference between the countries with regards to the extent to which product and service exports occur within the Germany context.

Supply chain respondents within Germany spoke of the high priority they place upon establishing high rates of export into different markets to ensure maximum commercial growth and profit. This was stated as a particular trend due to products and expertise originating from within Germany being believed to meet the demands of retrofit policy and regulation within other nations. This is of particular note when considering the UK and Germany, where members of the sample group detailed a significant benefit to them of bringing German origin products to the UK, thereby offering a level of performance which is considered to not be widely available in the UK's EERS sector.

This concept, in addition to opening up commercial avenues of profit generation, also permits an increased level of knowledge sharing and carbon savings. This concept of sharing retrofit knowledge and innovation for the good of sustainability is indicated by the following statement:

'Sharing across borders is also something I think is vitally important if we are going to really get the carbon emission levels down all over Europe.' (RG6- Retrofit best practice coordinator).

Exporting products and services is also deemed to provide a valuable way to grow networks, and work with a variety of different people, opening up the volume of projects and applications for a certain market offering.

The level of building physics and retrofit measure knowledge is the next area considered more prevalent within Germany than the UK.

Understanding exactly how a building operates in terms of the building physics is considered a key way in which Germany succeeds in providing higher performing properties. Respondents who stated this concept elaborated on its causality with the following factors:

- Higher rates of retrofit activity over a more extended period of time within Germany is the main reason why Germany is more informed with regards to building physics and how a retrofit scheme of works can impact a property. One area in particular stated is that of retrofit air tightness work and schemes designed to achieve passive house standards. It is acknowledged that the majority of existing buildings were not initially designed to be airtight and therefore real attention is required to ensure air and moisture flows do not negatively affect the quality of habitation within a building.
- It is also suggested that due to the higher level of completed retrofit projects in Germany than in the UK, the amount of learning from live projects is higher. This is of importance due to the fact that products when tested are only assessed with closed environments, and therefore a wealth of knowledge regarding how they behave in real life situations is considered extremely beneficial.

Having a good understanding of building physics was also considered to be a key way to ensure installed products have a good opportunity of reaching a level of performance near to that of the stated level by the manufacturer.

Following on from these aspects is the concept that fewer retrofit project managers are operating with the UK.

Respondents within the German sample group stated that their opinion was of a

higher level of roles within the sector for managers and consultants. This was stated as the case for the following reasons:

- Firstly due to the higher level of different products and innovations widely used on retrofit projects, the need to optimise these measures is important to provide an end project which performs in the most effective manner. Therefore, the role of project manager or consultant is important to enable this. This added expertise ensuring measures are correctly installed is also a key way in which to offer added carbon savings, as indicated by this statement:

  The most substantial savings can be made by installing the most appropriate materials and technologies, measures which will bring in the most carbon savings per euro, the second way of achieving better results is to ensure that all the different installs are completed in the correct order so that operationally on site things are completed efficiently. (RG12- Retrofit consultant).

- The degree of choice of possible project measures also presents a factor as to why a project manager or consultant is required. Due to the significant finance which can be accessed by end users, along with the options to choose between many different measures, means advisors are required to optimise a balance between the level of resources applied to a project and the resultant energy efficiency. This ensures costs do not escalate without the return of significant carbon reductions. This concept is highlighted by this statement:

  'I try to make sure that at no point are end users spending money unnecessarily, and that every penny spent in going to make a significant difference to the carbon output figures.' (RG12- Retrofit consultant).

  The concept of projects being cared for or looked after in a cradle to grave manner was also a theme emergent in the data. This business strategy is stated to entail the design, commissioning, installation and ongoing maintenance of a retrofitted scheme of measures and therefore requires management personnel to care for a project throughout this period. This is also linked to the concept of businesses completed different roles to generate multiple profit centres, ensuring increased control over a project and its quality. With these different profit centres, a significant level of

optimisation for a commercial perspective is stated to be required thereby adding to the roles and responsibility of management personnel.

The final area considered different between the UK and Germany is that of the perceived higher established nature of the market, causing higher rates of retrofit work taking place above minimum standards.

Minimal levels of retrofit and standards were also an area commented as divergent between the two nations. Germany is considered by the participants to have a higher rate of projects completed to standards higher that that required as a minimum. The reasoning behind this trend is detailed by the following points:

- Minimum standards within Germany are considered to produce an environment whereby even the least efficient buildings within the housing stock perform in a manner which makes them a comfortable, healthy and economical place to live. This is something which is not considered the case for the lowest performing UK homes.

- Operating above the minimum was also stated as a key way to produce projects which have the potential to pull policy and standard forward, due to the acknowledgment that increased performance is achievable. Therefore, in addition to the build process itself there is also the factor that policy interaction should happen post build, enabling policy learning from high performance, innovative projects.

- In operating above minimum standards there is also the concept that due to the unprecedented nature of the way in which projects are brought together at the higher performance end of the retrofit spectrum, innovative practices have to be generated in terms of project design, organisation and delivery, thereby enabling advancement on multiple fronts.

Future proofing was also a theme linking in with operating above minimum standards within the UK. In ensuring a project operates in a quality manner into the long term, high levels of confidence in the projects lifespans can be gained. This is due to incoming increases in minimum standards not causing a set of installed measures to become obsolete.

All of these factors highlighting the difference between the nations show that there is the potential for significant policy learning to take place. For UK policy makers to adopt

alternate strategies to better foster EERS sector conditions as experienced within Germany, which has outperformed the UK in terms of retrofit projects completed, in addition to carbon savings.

From these interview findings it can be appreciated that overall the EERS sector within the UK differs from that of Germany in many ways. The grounded theory methodology here is aimed at developing themes and findings as research is taking place, and therefore the insights shown above are what forms the foundations of questions which the focus group participants will discuss with the aim of developing ideas and insights as to how the EERS sector within the UK is to move forward into the future.

5.4 Group Interview findings

Group interviews were carried out within this research as a middle ground between individual interviews and focus groups. These were conducted prior to focus groups, and enabled a deeper assessment of themes emergent from within individual sessions. The group sessions provided an environment where due to the multiple participants more detail could be covered as to EERS sector performance and also policy/industry relations (section 5.2). In total 4 group interviews were carried out, one with Green Deal advisors and installers, one with retrofit product supply and retrofit advisors, one with retrofit consultants and one with property retrofit managers. These were all conducted within respondents' places of work, and lasted between 45 and 90 minutes.

From the results within these two previous sections, the following areas were theorised as emerging factors in need of further investigation and clarification, via the group interview sessions (table 19):

Table 19: Group interview discussion themes emergent from UK individual sessions

Group interview theme	Theme origin within individual interview data
Role of high quality, high cost projects.	Prevalence of statements within individual interviews of significant capital cost, high quality, high performance projects seeing an increase, and also being seen as an influential factor as to how the sector operates.
Role of product supply in enabling change.	Statements from product suppliers and other EERS sector businesses commented upon a success in the growth of dedicated sustainable building product supply centres catering for retrofit.
Issue of operating with outdated methods	Significant concern was raised within individual interviews regarding the unprofessional nature in which some EERS sector businesses operate. These operations where typified as using high levels of subcontractors which brought quality concerns, coupled with unprofessional customer acquisition methods, and a lack of project managers.
SMEs as a key group which need to be considered	Due to the high level of SME trade carried out within the EERS sector, tailoring of policy for smaller businesses was considered very important. In particular this was raised due to the high levels of due diligence experienced, along with compliance procedures making competition with larger businesses difficult.
Single or multiple profit centres	Mixed response from individual interviews as to whether individual or multiple profit centres is the best method in which to enable a successful business strategy. One area identified by the majority of respondents operating within policy delivery, was to utilise the assistance of any type of policy funding, however in taking this route, companies stated a need to become adept at lead generation and cash back administration.
Requirement of increased certainty	Forward planning and certainty is a key area stated as being in need of further assessment. This is in particular reference to the manner in which policy incentive funds are administered, and also the fact that increased certainty is needed to provide better conditions for investment and professional relationships. Furthermore, the concept of increased communication between EERS sector businesses, end users and policy makers was stated as a key method to enable this increased certainty.
Routes for improved finance provision and timescales	The provision of finance was also a theme considered in need of further study, and therefore the concepts of interest rates, and finance flexibility emerged as key areas for improvement. Moreover, interviews produced a high level of discussion regarding the mismatch between policy expectation and timescales, and the ability of the sector.

These themes are now detailed in terms of how the groups interpreted the issues and discussed the impact of the different areas upon the sector. The following tables present the aspects which were resultant from covering the above concepts (table 19) in the group sessions.

5.4.1 Role of high quality, high cost projects to producing retrofit increases

Table 20 details the breakdown of the different aspects emergent from group interviews, when the concept of the role of high end, quality retrofit projects was discussed. The different aspects are factors participants considered important to consider when assessing the role of high quality, and also aspects to focus upon to enable an increase in the frequency of high performance projects being completed.

Table 20: Group interview thoughts and discussions regarding high quality projects

Provision of high quality projects, specific aspects	Explanation of aspect
Creation of a trustworthy supply chain	Via a high quality supply chain delivering project to a high standard, and working with a variety of different measures and technology, an environment of trust can be generated. To continuously produce quality installs, experience is required and therefore reputations become more prevalent.
Reputation importance means moving away from profit focus	Participants considered if EERS sector individuals take the priority away from simply producing profit on each project, and instead look to boost reputation at every juncture, quality, carbon reduction, service and profit result.
Comprehensive service across different geographies	Quality considered as the ability for businesses to cater for a whole host of different projects, in all locations. Something considered of high value if the UK's housing stock is to be retrofitting comprehensively.
High quality characterised by high knowledge levels	The notion of high knowledge provision amongst those implementing a project was also considered a key pillar in the enabling of higher quality projects, as education of end users, along with the technique sharing could take place.
Flexible policy environments could provide opportunities for high quality professionals	It is considered that if the highly flexible and tailored route in which retrofit operates outside policy implementation could be duplicated to an extent within policy delivery, then high quality practitioners could expand their activities.
High quality linked to property price increases.	The establishment of a trend linking high energy efficiency and property price could provide an environment where homeowners and even developers view retrofitting properties as a sound investment.
Linking higher quality service with financial optimisation	Coupling highly knowledgeable professionals to a project can also provide increased ability for a project to be optimised financially. With this streamlining of project delivery, cost and time are both reduced.
Increased sector capability brings project timescales down	With a boost in terms of how projects are managed, and the level of quality and expertise practitioners are able to deliver, streamlining also leads to a reduction in project timescales, increasing end user appeal.
Higher quality brings increased project assessment	With increased performance levels of properties, it is considered that property assessment procedures will have to incorporate added rigour to ensure compliance and accomplishment of stated performance levels.
Improved ability of sector to bundle projects	Increased sector service could produce tighter management, enabling project bundling to bring singular project costs down. This ability to group schemes of work needs to occur via continuous improvement.
High quality as only pathway to future proofing buildings	Producing a property which performs to a very high standard by today's standard, also means into the future the building is anticipated to perform well, thereby limiting the need to carry out additional works down the line.

Therefore enhancement of retrofit project completion strategy is considered an important activity, with the usage of high performance projects acting as showcases to display sector capabilities. Furthermore, to achieve a sector capable of increasing its ability to cater for these types of projects, advances are required in how products and services are supplied, assessed and optimised, along with the increased provision of knowledge sharing and prioritisation of customer service and communication.

5.4.2. Role of highly capable supply chain is generating positive change

This section details the key aspects connected with the role of the supply chain in producing positive change in the level of retrofit activity via the delivery of products and service to other businesses and end users. The different aspects connected to this theme as mentioned by group interviews are detailed in relation to how the retrofit supply chain could alter to achieve improved impact.

- **Pushing policy to enable an increased level of products for inclusion in projects.** Policy schemes were deemed not open enough to new innovations and products, and therefore, not providing a way to push new methods of saving domestic CO_2 emissions. Communication therefore is required from supply chain businesses which is at a level policy makers can understand. This will enable an estimation of the value of a product or innovation, and determine a clear pathway to incorporate the new addition into an existing product offering.
- **Product supply chains as enablers of best practice 'show homes'.** In producing exemplar projects which showcase new innovation and practices, supply chain businesses can raise awareness of new methods, and provide projects which homeowners can aspire to live in and also policy makers can aspire to enable.
    - **Importance of the supply chain in providing new products in a competitive manner against more established methods.** Due to the importance of finance in determining the viability of a project, one key aspect within the material supply chain is to generate new innovations at competitive prices immediately from market appearance, and also to produce the new innovation at volume. Ensuring these two things means that purchasers can be confident that a more economical price cannot be achieved elsewhere and that the innovation or material can be purchased easily, and is stocked widely.

- **Looking innovatively at potential partnerships to foster knowledge development.**
  Utilising different sources of knowledge within supply chain activities can generate new ways of operating and new innovations. This was stated as particularly important when considering the role of academics and researchers in assessing the potential of emerging technology and materials when conceiving and specifying projects.
- **A good understanding of policy and the restrictions and opportunities it produces is required.**
  High performance supply chains need to be able to identify how policy is progressing, and the requirements it places upon businesses, then in turn a detection of the different commercial opportunities is required. This strategy has the potential to not only work well within the restrictions of policy, but also to focus efforts on certain measures and enable substantial progressions within areas which previously would not have seen such growth in commercial viability. Additionally, this method requires the establishment of high levels of adaptability and efficiency in how the supply chain operates, as rapid rates of change may be required to produce and bring innovations to market, or alter services to enable maximum economic growth.
- **High importance of creating trends to make retrofit more attractive.**
  High levels of continuous improvement and streamlining needed to ensure that retrofit projects are completed to high levels of quality, affordability and short timescales. It is considered that only with this progression will retrofit schemes become more viable and attractive for different client groups.
- **Successful supply chain businesses understand requirements of clients.**
  High importance for professional supply chain businesses to place a priority on the precise requirements of the client; this is of particular note when considering the differences in terms of private clients, housing association clients and landlords for instance. To enable this, a strategy which priorities customer service and after sales care is key. Furthermore, in addressing the exact requirements of the end user, added levels of project tailoring can occur, which permits increased carbon savings due to retrofit measure suitability.
- **Supply chain brings together standard property upgrades with energy efficiency.**
  To enable increased levels of retrofit energy efficiency activity it is suggested successful, high performance businesses bring together carbon savings improvements alongside standard property upgrades, such as bathroom or kitchen alterations. By

doing this, energy saving is enabled at points traditionally only catered for by standard upgrades.

- **High rate of innovation within live projects as a key aspect of quality supply chain businesses.**

  Live project working stated as a key method in which businesses can generate increased rates of innovation along with different ways new materials, products and services can be tested in real live conditions. This type of business activity is considered important if companies are able to promote their market offerings in a valid manner which has foundations within live real life scenarios.

- **Increased scaling of product and service offering important to ensure competitiveness.**

  Scaling up retrofit market offerings at a fast rate is deemed a key component of high performance businesses, due to the way in which new innovations are needed to emerge into the market immediately as a potential proposition for buyers. Methods stated in which to complete this is to increase scale rapidly to enable reductions per unit as soon as possible and produce an environment in which a product or service can be affordably applied to properties at scale. This scale is in turn appealing to larger scale developments such as housing association or landlord schemes.

- **Continuous improvement required to keep up with the evolving sector.**

  To remain competitive, supply chain businesses need to ensure their strategy is as efficient and streamlined as possible, to guarantee a minimisation of overheads and retain cost appeal for end users.

- **Need for supply chain to work with end users to maximise benefits.**

  One under used method stated as important to produce carbon savings via retrofit, is that of working directly with end users to ensure that any installed improvement is understood by the client, and that the end user is able to interact with the property in the most effective manner. This efficacy is important as it maximises energy and cost savings to the end user, and if the scheme of works is installed properly a healthy living environment can be achieved. Plus a close working relationship with the end user can result in project tailoring, which in turn has the ability to create a property most suited to the occupant.

- **Good supply chain correctly specifies products and services.**

The accurate specification of products and schemes of work is important to make sure that projects achieve carbon savings and also produce a building which performs well and is healthy to dwell within. This is of particular note with the data in reference to air movement and condensation; the concept that due to alterations in air flow rates, and air tightness, retrofit installation schemes can actually reduce property air quality. Therefore, in the case of the EERS sector, business need to be aware that not all product and service offerings are suited to all projects, and in turn there may be the need for businesses to turn down trade.

- **Importance of knowing how the building will behave post retrofit.**
  High performance supply chain businesses need to know how an installed scheme of works will behave post retrofit, these calculations could be in terms of U-Values in the case of insulation, or in terms of air flow and ventilation if in terms of air tightness and wall insulation for instance. The production of these calculations is deemed important for one priority reason; it provides a confidence in the predicted benefits of the installed measures, which in turn provides an impact in the EERS sector business's reputation.
- **Supply chain needs interaction with project designers/architects to produce accurate project specifications.**
  To enable a streamlined scheme of works, and also to produce a tailored list of installed technology and materials, it is suggested that the supply chain should work with professionals involved with projects upstream from the actual installation, to ensure accuracy in project specification.

All of these different factors listed above show that overall the supply chain can improve via numerous different routes. All these concepts highlight that for group interview participants, advancements to increase professionalism is possible via multiple routes. These concepts will be deliberated further with focus group sessions to generate insights into exact pathways of change.

5.4.3 The issue of using outdated methods, and why change is required

Table 21 details the key aspects connected with the fact that a reoccurring theme within the individual interviews was the issue of the EERS sector relying upon outdated operational methods to complete works and perform as commercial entities. From this, within group

interview sessions the concepts investigated further, with questioning focusing in on assessing what areas in particular are in need of alteration and why.

Table 21: Explanation of different areas for improvement to reduce reliance upon outdated operational methods

Issue of operating with outdated methods, key theme aspects	Explanation of aspect
Policy fund maximisation as a key outdated aspect in need of amendment.	The concept that businesses attempt to promote policy fund take up with clients to an extent which is as the detriment of retrofit measure suitability, is a key area which is deemed outdated. From this there is the need to strike a professional balance between promoting retrofit and ensuring growth, but also guaranteeing that customers are cared for correctly.
Accreditation schemes as areas considered outdated and in need of change.	Schemes of accreditation are considered in need of change due to the level of businesses deemed to be trading under an accredited label, but still providing a substandard level of service. Therefore the call here is to produce an accreditation scheme which prioritises a high level of assessment and quality control.
Customer acquisition methods in need of updating	Cold calling in particular is considered an outdated aspect of the industry. This customer acquisition method is considered detrimental for the fostering of a quality professional EERS sector image. Furthermore, this type of customer approach method is paralleled with more unscrupulous business types and therefore needs attention to provide distance from these companies.
Requirement to progress from poor performing online resources, to comprehensive websites for maximum information diffusion.	Up to date, well managed online resource are required to provide a one stop shop for end users offering an easy portal from which to gain a high level of information regarding retrofit. This is of particular note due to the requirement to move away from resources such as the Green Deal Orb which of many businesses being unable to respond to client requests.
Increased levels of administration skills needed for professionalism.	Increased EERS sector ability needed in terms of administration and finance management, particularly within SMEs to ensure high levels of professionalism, financial sustainability and also a quality customer experience.
Improved property assessment methods required.	Property assessments need to improve in terms of data type, accuracy and detail, permitting increased knowledge of property intricacies, thereby aiding project tailoring.
Increased levels of client and practitioner collaboration required to enable increased innovation.	Increased adaptability required from installers and project designers to work with clients to move away from conservative methods of retrofit and instead complete onsite innovation to optimise schemes of work. This progression is required to be driven by both the client and professional.
Focus on U values and air tightness not always appropriate.	Movement needed from simply looking at U values and air tightness levels and instead a focus is required more holistically as to how a property operates and how buildings need to be optimised.

In a similar way in which group interview participants stated supply chain operations could be improved (5.3.2), a move away from outdated methods was also detailed as routes which could take many different pathways. To distil further the route forward for the sector away from these negative practices, suggestions of improvements are discussed within focus group sessions.

5.4.4 The role of SMEs in retrofit delivery and why progress is required

Following on from the prevalence of SME statements and discussions within the individual interview stage, further exploration of this particular EERS sector aspect was considered important, to firstly assess its role in expanding the level of activity of the sectors, and also assessing routes which could be pursued to enable this change. Findings of this exploration are detailed within table 22.

Table 22: Group interview data regarding the role of SMEs with retrofit project delivery.

SMEs as a key group for consideration	Explanation
SME structure suited to individual projects	SME's due to their relative small size, mean they are in many ways suited to individual projects due to the nature in which the personnel can dedicate themselves to a project. This is considered a positive due to the option for attention to detail and customer service.
High levels of business training needed to ensure sustainable EERS sector	Financial knowledge and business acumen a key aspect of SMEs which needs to be prioritised to ensure that smaller businesses are able to sustain a commercial strategy of growth.
SME niche status key for competitivity	Due to the lack of competitive edge in terms of economies of scale when considering SMEs vs larger organisations, it is key for the smaller enterprises to establish a niche, within which they can compete.
Delivery networks important to enable large project capabilities.	High importance on the ability of SMEs to work within partnerships and collaborative networks to increase performance and capability when considering how to deal with large, or more complex projects.
Diversification needed so SME can trade unaffected by policy changes.	Due to SME limited finance levels, vulnerability to change is high, this means that high diversification is required to span lean business periods and also tackle policy changes in a manner whereby lasting damage is not done to the business strategy or structure.
Importance of sub-contractor vetting if SMEs are catering for large projects.	One concern raised is that due to SME businesses using external skills and sub-contractors to tackle larger projects, detailed assessments of sub-contractor ability is required. This is done to ensure that they are capable of delivering a project which is high in quality and therefore is competitive with larger outfit operations, which can complete jobs via in-house expertise.
Project managers needed to bring SMEs together within a project.	The role of project manager is important to ensure that SMEs brought together within a project does not require extensive client input to coordinate site processes. This is of importance as it can provide high levels of confidence with the installation and project delivery progress for the end user.
SMEs have an important role to play in determining policy future.	Prioritisation of communication with policy makers and the administration of policy required to ensure that SMEs and self-employed practitioners have the ability to convey their requirements, and how their role within retrofit delivery can be improved into the future.

What is evident is that SMEs form a vital part of the sector's delivery methods, and if large scale increases in retrofit activity are to be generated, market modification are considered important. This modification is suggested to provide additional avenues to enable smaller business to complete works year round, making operating within the sector a reliable professional career choice.

5.4.5 Profit generation and business strategy

The different routes companies take to generate income and remain financially sustainable were stated as being very divergent within individual interviews. In assessing further business routes, an insight can be made as to the UK EERS sector's performance. This in turn tackles the objective; *assessment of the performance of the UKs and Germany's EERS sectors, in relation to policy mechanisms required retrofit growth.*

The following are key aspects of the singular/multiple profit centre debate. Opposing viewpoints and their reasoning are presented.

- **Multiple profit centres considered as a strategy to mitigate against risk.**
  Due to the high prevalence of SMEs and self-employed individuals with the EERS sector, adopting a route of multiple profit centres is considered a valuable way in which to ensure risk aversion and providing a barrier against sudden sector or policy changes.
  - **Sub-contracting used within multiple profit centre routes requires careful management.**
    Respondents operating multiple profit centres suggested that performing within more than one area of business entails a higher reliance upon sub-contractors. This reliance can be considered as both a positive and negative, as it offers increased flexibility to cater for larger projects, but also it can cause quality control and chain of responsibility issues.
- **Multiple profit centre emphasis increases skill sets.**
  Business strategies which follow multiple profit centre routes, offer a pathway to provide an increased level of expertise, due to the added level of problem solving required on different project types. This is also the case for the manner in which companies are run, due to the stated higher level of business acumen required to operate different profit centres.

- **Multiple profit centres required to enable sufficient income generation.**

  An multiple profit centre strategy is considered the only way to generate significant financial returns, due to the fragmented nature projects are considered to come to the market. Therefore, it is important for businesses to offer more than one area in which they can serve an end user.

  - **Delivery of multiple profit centres important to produce increased level of income per project.**

    Due to the necessity to bring together multiple profit centres, it is considered that when completing more complex processes, or delivering a mix of services, it is believed that overall wages can be increased due to the added skills and expertise required. One example given of this is the difference of purely installing solar panels, and installing a low energy smart technology power system within a property.

  - **Sharing of overhead costs can occur when carrying out multiple income generation routes.**

    Businesses operating different income routes, can share overheads between these profit generation pathways, and therefore can enable a competitive end price to the clients, increasing the potential level of growth.

- **Working in multiple areas offers increased awareness of market developments.**

  High flexibility required to ensure that businesses are prepared for all eventualities, whether due to policy or market changes. Therefore it is important to be aware of all different types of measures, emergent technology and developing policy. It is considered here that to enable this knowledge a multiple profit centre route offers increased awareness than singular profit routes.

- **Less opportunity to bundle projects when multiple routes to income are chosen.**

  One downside of operating a business which has a strategy to generate different routes of income is that there is less focus on bundling projects.

- **Increased levels of expertise needed when operating different processes.**

  Installing similar products, or carrying out similar processes, does cause issues of training availability and career development. Therefore, adopting a multiple profit routes does present the need for increased training and expertise.

- **High levels of finance and resource management needed to make a multiple profit route business sustainable.**
  Multiple profit generation businesses do require increased monitoring and management of finances and resources in general, due to the way in which their operations are spread out. To ensure a business is sustainable financially therefore, added assistance may be needed from lenders, to ensure costs are kept stable and well managed.

What is evident from the discussions within group interviews is that overall specialisation versus multiple profit centres is a key area where different sector actors disagree. The benefits of being able to derive income from various areas of retrofit activity are evident. However it is also important to note that to achieve success in these numerous areas, significant levels of knowledge and management skills are required. This concept of business strategy will be further assessed within the focus groups, to determine exactly how improvements could be made into the future.

5.4.6 Group interview opinions surrounding the need for increased certainty

A reoccurring theme from EERS sector practitioners is that the level of certainty that they feel from operating within the industry is too low, resulting in a lack of willingness of business to invest, recruit, become accredited and train staff. Participants within the group sessions had numerous opinions as to the need for increased certainty, and also methods of improving the situation (table 23).

Table 23: Group interview findings as to opinions regarding the need for increased certainty.

Requirement for increased certainty, key aspects	Explanation of aspect
Long term certainty needed as to conditions into the future.	Increased certainty required to provide an indication as to future conditions of the market and policy incentives. Only within this certainty can focus be applied to positioning EERS sector businesses correctly to best serve members of the public who wish to take advantage of the incentive scheme.
Investment thwarted due to uncertain conditions into the future.	Limited opportunity for smaller companies to commit financial resources to business development due to the lack of market condition certainty. Moreover, businesses that carry out development in certain areas have to take on the risk themselves and place significant levels of investment internally.
High market uncertainty limiting commercial willingness to innovate.	Lack of certainty creates a purely reactive EERS sector which is reluctant to innovate and invest in case favourable conditions emerge into the future which they could be on the wrong side of. In this sense it is important for market corrective policies which come into place to prioritise innovation.
Uncertainty brings 'boom or bust' attitude to incentive policies.	Uncertainty in market conditions forms a 'boom or bust' commercial situation whereby any preferential scheme is maximised as quickly as possible. This produces issues of aggressive selling, rushed works, limited quality control, and poor customer service.
Intelligent capital needed to produce favourable commercial conditions for EERS sector businesses to work in the long term	The issue of uncertainty is believed to be overcome with cross party agreements, making them operational over a long term period, outside standard political timescales. However, it is considered that an inputting of finance which is designed to create favourable condition for business to invest and grow is the best method forward, due to its reduction in policy support which is detrimental to a self-sufficient large scale EERS sector.
Uncertainty as a draw on resources.	Changes in market conditions and policy incentives are stated to cause a significant workload to ensure that practitioners and businesses are continuing to optimise their business strategy and produce maximum profits.
Changes overtime bring in different measures.	Alterations in the way in which policy encourages different types of measures at different times, is considered a positive influence as it enables properties to become more viable for retrofit at different times.
Phased introductions of policy changes required	Increased certainty in the sector could be created via phased introductions of policy. With particular reference to the Green Deal, respondents considered more time was required for supply chain formation.

5.4.7 Group interview opinions of how projects are financed and what timescales they work towards

How projects are financed and the resultant timescale to which they run was the final key theme emergent form the individual interviews. This was deemed in need of further investigation to assess the underlying aspects to investigate when considering the role of finance within retrofit. The findings of the group sessions and the given explanations of these aspects is detailed within table 24.

Table 24: Group interview findings supporting the need for improved finance and timescales within retrofit

Routes for improved finance provision and timescales, aspects to consider	Reasoning
Incentive schemes cause the application of set measures to properties which may not be suited.	The issues of having limits and minimum conditions to policy incentive schemes, means that some EERS sector businesses attempt to suggest unsuitable measures for a property to enable a client to take advantage of an incentive, or loan scheme. This is stated to cause issues in some instances whereby end users are left with a large cost, and a property which may not be optimised.
Interest levels in need of attention to reduce burden on end users	Regarding the Green Deal loan system, a major issue as to why the scheme only had minimal uptake was due to the high interest levels attached to the finance. Respondents believed policy makers misjudged end user appetite for debt. Furthermore, the loan finance was stated to be insufficient for most measure plans, therefore requiring client contributions. To enable a loan system to operate successfully attention is needed as to exactly how much risk is linked to the money and lender.
Increased linking of high energy efficiency with property values required.	Due to many end users being driven by the financial aspects of a project, and viewing improvements as an investment, it is important to ensure that overall higher energy efficiency properties can demand a higher price on the open market. This is evidently a significant social change to create this change, however one route suggested to produce this alteration is to increase the level of taxation for high carbon output buildings, and put in place high levels of rebates for energy efficient homes.
Increased awareness and information of the real cost of inefficient living	Increased level of awareness and advertisement of the added value of retrofit works as a stated suitable strategy to enable increase retrofit uptake. This could be suggested via EPC data, with increased data detailing possible routes for higher energy efficiency. This in addition could be linked to smart real time data as to how much energy is being used, and the real cost of energy inefficient properties.
Increased time period required to spend retrofit incentive funds	Longer time periods are required to spend policy funding to enable works to be thoroughly thought out, and completed in the most economical and efficient manner.
Tailoring of finance provision required to different section of society	More consideration required as to exactly who the end users are, this concept is emergent due to the Green Deal loan scheme being considered to be mismatched to the people is was designed to serve. Those homeowners wishing to carry out retrofit schemes of works were deemed to be aged 40 plus, with a mortgage, and therefore taking on a high interest loan is not something they need necessarily do.

5.5 Focus group findings

This section presents the results of three focus groups carried out to explore the themes that emerged from interviews and group interviews. This is shown in Table 25 which details the pathway taken from between the data collection methods. The participants included in these sessions were installers, suppliers, project manager, retrofit advisors and energy efficiency consultants. Focus group 1 was conducted with different stakeholder completing a passive retrofit in the North West of England, focus group 2 was carried out with practitioners conducting a small property retrofit, and focus group 3 sector individuals involved with a timer frame retrofit project. The sampling methods utilised for the focus groups consisted of building groups of different participants for different backgrounds, with the aim of producing an environment which can provide insight into the above themes and how changes could be made to enable increased retrofit activity. To provide additional insight, existing networks from live projects were selected as a way to provide groups of practitioners which not only can discuss how the UK's situation could improve, but also how their own network has operated and could be improved, thereby adding situation evidence to insights.

First group interview themes are detailed, which in turn were informed by the individual interviews and their foundation of EERS sector data. These resultant themes are then coupled with similar themes from within the Germany interviews to inform how the focus group questioning route should take place. This step by step data collection process highlights how the grounded theory nature of this research increased knowledge as the process progresses. Therefore, the researcher becomes more and more aware of relevant concepts and themes which require additional attention.

Table 25: Focus group questions emergent from individual interviews, and group interviews.

Group interview theme	German interview themes	Focus groups questions
Role of high quality, high cost projects to producing retrofit increases.	Higher prevalence of deeper retrofit schemes	Questions aimed at assessing focus group believe as to the potential for high performance projects and deep retrofit schemes to promote retrofit activity.
Role of product supply in enabling change.	Product supply businesses are in the main determined by buying groups, limiting the role of smaller businesses	Route of questioning to analyse the extent of the value of innovations to boost retrofit activity.
Requirement of increased certainty	Perceived higher levels of innovation from German EERS sector practitioners	
	Product and service export prevalent within German EERS sector	
Issue of operating with outdated methods	Knowledge of building physics stated to be widespread in Germany in comparison to the UK	Questioning aimed at assessing the potential routes to increased practitioner knowledge and ability.
	High volume of roles for practitioners managing retrofit projects	
	More established nature of the market means high rates of working above minimum standards	
Single or multiple profit centres	High priority placed upon streamlining and creating efficiency of delivery	Route of questions aimed to elaborate upon business strategies and profit generation routes
Routes for improved finance provision and timescales	Prioritisation of customer service within the German EERS sector	Questions designed to highlight interactions with customers and related finance levels for retrofit
	High level of awareness in energy efficiency and low carbon living	
	High levels of customer finance available for retrofit	
SMEs as a key group which need to be considered	Networks important to ensure work completed in a streamlined, quality manner	Indications of how smaller EERS sector businesses and related networks operate searched.

The following section detail the findings from these questioning routes (table 25) and presents an initial view of how different aspects and improvements could be brought in to improve retrofit activity. These suggestions are then presented in further detail within chapter 6.

5.5.1. The role of high performance projects

From table 25 the first factor discussed within the three focus groups was the 'role of high quality, high cost projects to producing retrofit increases. The resulting thoughts are shown in figure 10. This figure highlights a range of supporting comments emergent from the focus groups, describing the value of high performance properties, as a showcase of EERS sector capabilities.

Factors agreeing with the value of producing a network of high performance properties to showcase the capabilities of materials, skills, technology and design.	- Creating a network of early adopters creates confidence for the rest of the market. - As an information gathering exercise, creating a database of high performance properties offers a very real and live indication of what other home owners could produce and at what cost.
	- The importance of gaining insight into how products and processes work onsite, prior to working with new innovations themselves, thereby limiting the risk that the installation and project may fail due to ineffectiveness of suggested measure schemes.
	- Using high performance properties as marketing tools by using them as case studies enables possible clients of EERS sector businesses a viewing of their work. Also a link into a network of differing sector business which operate within a certain geographical location and could contribute to the completion of a project.
	- Practitioners can also benefit from being involved in high performance projects which then act as exemplars of the capabilities of the market in that they permit free advertising, and the linking of a quality end project to their positive reputation.

Figure 10: Factors emergent from focus groups agreeing with the value of producing a network of high performance properties.

In order to improve the level of retrofit activity into the future the feedback from the focus group suggested the increase in number of high performance properties or 'Super Homes'

acting as case studies of what is possible.. The first suggested strategy therefore is to increase the level of incentives to produce an innovative property national portfolio, which is marketed and advertised as a tool for learning, testing new products, increasing public awareness, and generally pulling forward the expectations of end users. One representative focus group quote which highlights this follows.

> *'You can go and look at a very high energy efficient standard build with all the technology and mod cons, everything completely up to date, and say you can do a bit of this, or you could do a bit of that. Then I think what people could do is look at the possible things they could afford to do to, and then look at what policies are out there either to gauge what minimum things you need to achieve, or indeed it there are any incentives available to help you on the way in your project.'* (FG3R3- Energy advisor).

All participants agreed that it needed to be linked to a published guide from the case study projects, which offers a high level of insight and clear data as to exactly how the project was carried out and what businesses were involved. The enabling of this process was suggested to entail the input of finance from businesses involved within the projects, thereby providing a reputable, professional way in which members of the EERS sector can market themselves. Some respondents emphasized the inclusion of incentives of rebates, including council tax rebates for promotors of energy efficiency and those willing to open their home to other members of the public, and also a possible elimination of stamp duty if a property acts as a 'Super Home'. A representative quote is given below:

> *'One way which I think is a relatively easy win, is to get those keen early adopters to promote their properties, and really act as a marketing tool for the industry, so a potential incentive fund to get that going successfully would be a good move.'* (FG1R1, Retrofit insulation installer).

An establishment of a large geographically disperse network of 'open' properties was deemed a step in the right direction to encourage members of the public to engage with the EERS sector, and for the sector to generate possible business routes. Furthermore, it was also stated that this process may enable an increase in the strength of the link between high energy

efficiency and higher levels of property value, therefore developing the process of retrofitting as an act of investment to actively increase the value of a building.

The participants linked this concept of connecting retrofitting with the correct levels of finance to the fact that overall development in the level of finance and the way in which it reaches end users is needed. This was of particular note in relation to the perceived important role of finance in purchasing a wider range of innovations, enabling deeper retrofit levels, and in turn developments within the EERS sector. The casing point here was the GD and the fact that it provided finance at a level which was simply not attractive enough to entice end users to take the scheme up. Resultant suggestions from the respondents as to what schemes could replace the GD's loan system was centred on getting retrofit finance as much into the mainstream as possible, with high street banks providing re-mortgaging and personal loans. All participants agreed that as the mainstream financial institutions do not presently have mechanisms in place to assign risk levels to retrofit schemes, increased levels of monetisation of projects is needed.

On the business side of the customer/practitioner relationship, attention was also suggested to be required to produce more properties of a high performance standard. In particular increased training and accreditation was stated as necessary to enable a sector which can provide high performance projects at competitive costs. This was stated to entail the generation of a large number of time served practitioners, ideally training via apprenticeships style schemes, which promote a high level of problem solving and continuous improvement to ensure new methods and products are being considered for project inclusion. This sentiment is exemplified by this respondent comment;

> *'We went down the training provision route because we were in desperate need of a system to ensure that the performance values we were quoting for jobs were going to be experienced by the end user, and that these new materials being installed worked.'* (FG1R2, Breather Membrane installer).

This factor also included the notion that practitioners also need to start operating well managed financial business arrangements, ensuring stability within the sector, and the fostering of long standing positive reputations of businesses. This reputation element was also linked to the fact that a database of high quality practitioners and businesses needs to be

compiled to ensure that end users can access a significant number of different supply chain actors, who can swiftly complete a project.

5.5.2 The role of innovation

The role of innovations and the level to which new energy efficient technology, materials, and processes was the next area highlighted from within the group and German interviews as a possible area in which progress needs to be made.

Figure 11 shows the breakdown of the suggestions made by respondents in the 3 focus groups as to the different strategies which could be adopted to enable increased levels of change and innovation adoption

Areas for improvement to enable an increase in the level of retrofit innovations	-Large product supply businesses and national suppliers need to lead the way in changing the status quo of the market and providing at a large scale, new innovations which are marketed widely. -Smaller businesses bringing products to the market, do not have a significant financial reserve for large scale innovation promotion, and therefore change needs to be led by larger companies.
	-Significant fund required to enable large scale boosts in the level of innovations being released. One suggested route is similar to the previous Technology Strategy Board scheme which applied different tranches of finance for innovators, but with additional partnerships of small innovating businesses and individuals with consultants, in a fast track environment to push a product in exactly the right way.
	-Innovations to be brought forward via a coupling of an incentive scheme and an early adopters fund such as that of the Green Deal. Therefore, new innovations could be entered into an approved database which includes a range of differing products which are in need of increased adoption, uptake of a new product could enable a discount and specialist consultant assistance via the fund.
	-The formation of a government organisation to identify emergent innovations and processes for inclusion in product databases and retrofit incentive schemes is deemed important. This organisation would mean a high level of selectivity to ensure that only quality, high performance products are making it into the market, and received assistance.

Figure 11: Focus group emergent strategies for improving the level of innovative activity within the EERS sector.

5.5.3 The role of training

From table 25, the level of training and the extent to which expertise is the foundation of a progressive, professional EERS sector, formed the third area in which additional investigation was deemed necessary. The following figure (11) presents key suggestions made by the majority of respondents as to how the sector could improve into the future to enable increased retrofit levels. Due to the complex nature of retrofit activity, and the high amount of labour intensive processes which are involved within delivering a scheme of work, the extent of training, and the way in which practitioners complete works, was considered vitally important.

Strategies to increase the role of training in boosting retrofit activity	-Perceived lack of public awareness considered a key problem in enabling an increase in retrofit activity. Therefore the role of EERS sector practitioners and the knowledge sharing that could be carried out between the sector and clients was stated as being very important.
	-Training in specification of products for differing projects and also the buildings physics side of retrofit is deemed a key area in which additional training is required. Considered important for three reasons, firstly via this route end users would receive increased learning and knowledge, secondly retrofit process would be completed to a high standard as practitioners understand how measures should work together, and thirdly this strategy would create buildings with a lower carbon output.
	-Increased training in terms of how processes are carried out beleived to provide a productive way in which to streamline retrofit processes and reduce the protracted nature of some projects, therefore offering an attractive prospect for clients to invest. The fact that this method could also produce more certain chances of high quality levels, was stated as a key reason to prioritise training.
	-Operating alongside additional EERS sector training requirements, is the need for further accreditation to ensure that ongoing quality is being met, and the increased training necessities are being complied with. -Accreditation was considered important to ensure that outfits investing in higher training levels are not undercut by those with less training, emphasis on quality. Therefore, a high differentiation between what businesses can offer was considered key.
	-Training important for the introduction of project managers within the EERS sector to ensure a more streamlined delivery on site. This is because a high expertise individual can provide significant levels of organisation, scheduling and problem solving.
	-Timed served apprentiships were considered a key way to train individuals to be able to deliver high quality projects, problem solve on site, be aware of differing products and solutions, run a finanically stable business and devleop experience of lots of differing techniques and methods. This would enhance the level of customer experience and positive reputation of the sector.

Figure 12: Focus group suggested strategies to increase the role of training in boosting retrofit activity

5.5.4 Business strategy and profit generation methods.

The fourth area discussed in the focus group setting is the importance of careful selection of business strategy and profit generation routes to ensure an EERS sector operation is financially stable in the long term. Figure 13 details emergent concepts which were discussed to encourage increased financial stability within the sector.

Suggestions into the future to enable financial stabilty of the EERS sector.	-Commercial strategies which position practitioners within networks, was considered important and something to be fostered, particularly in the case of smaller businesses, and self-employed practitioners. This was suggested primarily due to the benefit of passing work amongst network members, and also sharing opportunities and knowledge. Furthermore, it enables practitioners to provide specialist skills for other network members, increasing the level of quality for end users, as stated by the respondent quote; 'I think that if a network is formed correctly with the underlying ethos drilled into members, then it could work as a way to ensure people keep quality standards high.' (FG1R1). The level of ease for the client to find contacts to complete works was also considered important, due to the network permitting linkages for differing tasks related to a scheme of works.
	-Multiple profit centres were expressed as being a good method of ensuring that a business or practitioner can operate in an sustainable manner financially over a long period of time. However, this was stated with the proviso, that a highly adaptable attitude towards the requirements of the market is required, along with a level of expertise which can problem solve and absorb new techniques and products quickly. Working in differing manners, and yet delivering a level of quality which rival a specialist was considered a key way in which to achieve customer satisfaction, due to the reduction in points of contact within the sector, and a high likelihood of on time completion.
	-In a similar manner to that of the training requirements to enable increased numbers of project managers, there was also the statement that adopting a role as a manager, in addition to other profit making methods, could produce a strategy of added income with minimal additional overheads.

Figure 13: Strategies of generate increased levels of EERS sector financial stability.

5.5.5 Customer service and finance generation

The aspect of EERS sector communication with end users, and the way in which products and services are purchased is the next area which was considered within the focus group environment. This was completed to investigate how the sector could be modified into the

future to be more appealing and attractive to potential buyers and clients, thereby enabling retrofit awareness growth, along with retrofit activity. The following aspects (figure 14) were established as areas in which attention could be applied to enable added EERS sector appeal to end users.

Suggestions into the future to enable increased EERS sector appeal for end users.	The first statement related to customer appeal, is that overall, projects of high quality and a significant emphasis on collaborative working between sector practitioners and clients, are external to policy incentive schemes. Therefore, projects which have customer service at their hearts, are those schemes of works where the client is heavily involved, meaning for these types of projects to multiply, awareness increases are a key factor which needs to be improved. Moreover, with increased awareness of retrofit processes, added knowledge of costs, and the value of retrofit works and their financial benefits are stated to result. This increased financial knowledge is considered to further promote end user engagement with leading a low carbon lifestyle.
	Another method stated as an important suggestion to ensure added end user engagement, is that of providing rebates or discounts to home owners who do achieve a higher performance property. It was suggested that if a project is completed which is towards a high SAP rating, or indeed carbon neutral, then stamp duty or council tax rebates should result, thereby providing an incentive to progress the retrofit sector to a deep level. In addition this is considered a clear way in which to assign a financial value to energy efficiency, assisting the modification of the housing market to value low carbon buildings in a higher manner.
	Increasing the level of finance available to end users was also stated as a key way in which to achieve a higher level of retrofit activity, due to the consideration that finance limitations are the primary reason why a higher number of deep retrofit projects are not completed. Therefore, producing a public fund which could be accessed by members of the public, to complete high performance, deep retrofit projects was considered a positive step for the sector, and for carbon savings. Connected with this point is also the concept that a fund of this type needs to be more widely advertised and available and therefore engaging mainstream banks to literally get the concept of retrofit onto the high street.

Figure 14: Strategies to increase EERS sector end user appeal.

5.5.6 The role of SMEs in delivering retrofit schemes

A continuing theme within the German and group interviews was that of the high importance of SMEs in delivering retrofit at scale. This was stated as the case due to the individual nature of retrofit schemes, and also the high geographic dispersion of projects, making bundling for larger businesses more difficult. Therefore, the concept of increasing the success of the role of SMEs was discussed within the focus group setting and resulted in the following suggestions for pathways into the future (figure 15).

Suggestions into the future to enable increased SME contribution to the level of retrofit activity	Smaller businesses joining together in a cooperative style was suggested as a key way in which they could become more competitive with larger businesses, this way bundling of projects could start to occur, but with the advantages the smaller businesses provide, such as tailoring of appraoches, and attention to detail.
	Linked to the previous point however, is the fact that to enable this increased competivity with larger businesses, intermiediries are stated to be required to support groups of SMEs and self employed practitioners. This support may be in the form of business or project management skills to administer a project.

Figure 15: Strategies to enable increased contributions of SME businesses.

5.6 Conclusion

In conclusion the results here show a variety of different aspect affecting the EERS sector and its task of increasing retrofit levels. Firstly, business strategies and tasks within the sector we highly variable, displaying the fact that business can succeed appealing to dissimilar customers. This in turn displays the wide nature in which the sector can be characterised. Furthermore, the different business types generate opportunities for innovative methods of working between businesses and partnerships to form niches in commercial activity. These characteristics are corroborated with findings from existing research, or particular note Goldman et al. (2009), and DTI (2006), detail this high variance in business type. However what can be seen as different from these studies is the high prevalence found within this

research of SMEs playing a core role in delivering retrofit measures, which in turn focused upon the importance of generating partnerships between businesses.

However, due to the high level of evolution within the EERS sector, issues are still being ironed out, issues such as low quality, outdated methods of business being used, along with a lack of training and management to cater for the complexities of a retrofit scheme of works. Reasons which have the potential to be causes of this outdated manner of working are stated to include policy schemes which are insufficient in terms of finance and suitability, siloed delivery chains, issues of quality of accreditation and a lack of flexibility of market conditions to cater for the intricacies of retrofit. These issues hindering the progress of the sector were also in many ways mirrored within the existing literature.

This outdated working manner and siloed working methods was also apparent within literature, connected to the factor that due to economies of scale being difficult to generate linking of businesses is difficult (Mundaca, 2007; Genovese et al, 2013). However the literature went further to detail current strategies to combat this disintegration including that of cooperative style collections of SME retrofit companies; cases include South East England based RetrofitWorks, and the national independent business group named SNUG (Fawcett et al, 2014). Furthermore, the findings of a lack of suitable finance for sector growth along with flexibility in market conditions were highlighted within the existing literature. Rosenow and Eyre, (2016) underlined the fact that policy was required to tend to this need for flexibility. However, what was also evident within this research is that on top of the flexibility required from policy is the fact that to permit higher levels of innovation increased adaptability is needed in terms of how business operate and how projects are completed.

In the case of Germany, these issues of flexibility and policy suitability were considered lessened due to policy schemes permitting high levels of flexibility in terms of finance availability and retrofit project, furthermore retrofit activities are considered a staple of a well-developed, time served construction industry with accreditation at its heart. This was also supported by German literature, including Amecke et al. (2011), who detail the wide range of policy instruments enabling retrofit project of many types. Galvin and Sunikka-Blank (2013), also take this notion further, detailing the financial case for this policy setup permitting a wider range of retrofit works. What is less clear within the existing literature is the value reported here of the time served and well trained element of the majority of German

tradespeople. Therefore it is not entirely clear whether specialist retrofit training programmes or apprentice style route have enable the relative success of the German EERS sector.

From these findings from the individual interviews, group sessions then produced the following strategies to move the EERS sector forward within the UK; firstly high quality, high performance projects need to take precedence to both stretch the capabilities of the sector, and to also increase the ambition of society as to what their property can be like. This value of quality project has been detailed in some way within the literature, mainly under the concepts of Superhomes (Fawcett and Killip, 2014), and the way in which the characteristics of these projects is worth attempting to replicate. The concept of increasing the capabilities of the EERs sector via these projects however, is yet to feature within the literature, and therefore takes the value of these Superhomes even higher. Secondly, outdated working methods need to be changed via the introduction of training schemes, online resources and assessment procedures. Thirdly, SME involvement within the sector needs to be prioritised due to their ability to cater for individual project and form working relationships with home owners. This SME role features within the literature, however it does so in terms of how smaller more traditional construction practitioners are adding an energy efficient element to their offering, and therefore not specifically trading as an energy saving retrofit outfit (Janda et al. 2014). Fourthly, to assist both SMEs and larger business added certainty in policy schemes is required to ensure long term business strategies can be produced , along with innovation of product and processes. This was also an element which was found to be in some way parallel within the literature, most explicitly with regards to how to enable innovative practice to evolve market conditions need to be more stable (Fawcett et al., 2014; Killip, 2013). However, the manner in which this factor took precedence within this research, show a level of importance higher than that reported previously, particularly with reference to the need for incentive schemes such as the GD to be static for longer periods.

Chapter 6. Future evolution of the UK's EERS sector, pathways to increased retrofit activity

An examination of data presented in chapter 5 in relation to how it links with existing research and the relationships between the EERS sector and policy is furthered by suggestions as to how the sector will progress into the future. This is anticipated to provide a strong understanding as to the role the EERS sector is likely to play into the future, and the way in which it could contribute to a transition to a sustainable UK society.

6.1 Expected changes to the EERS sector population

Due to the way in which themes emergent from the data suggest that overall low quality and cowboy operations should be phased out and every possible method used to promote professional high quality mechanisms, one expected change is for increased rigour within the sector, as is corroborated with existing research (Janda et al., 2014; Rosenow and Eyre, 2016; Owen et al., 2014). Furthermore, it is expected that some variants of EERS sector businesses are likely to struggle more than others, in particular those relying upon one singular type of policy implementation work, exposing the business to high levels of risk if the policy changes. In contrast it is expected that the EERS sector businesses that prioritise quality, multiple profit centres, customer service, innovation and careful financial management will enjoy the greatest traction when gaining future trade (Koh et al., 2012). However, although it is expected that some sector business strategies will likely flourish more than others into the future, it is predicted that a broad range of distinct businesses will remain, tending to the varying needs of different clients (Gooding and Gul, 2016; Koh et al., 2012).

Data themes also suggest that there is space for continuing development of the sector, with increases in the level of human resources and businesses active in the sector needed (Owen et al., 2014; Killip, 2012, 2013). In relation to these opportunities for new businesses, it is considered that for companies and practitioners to succeed, operational efficiency is of high importance to ensure competitivity (Fawcett et al, 2014; Koh et al., 2012; Marchard et al., 2015). However, it is also expected that these new-comers will have to establish partnerships with other EERS sector practitioners and more traditional trades such as carpenters, to ensure projects are completed in a deep and quality manner (Janda et al., 2014). Alongside this aspect, was also the consideration that newcomer organisations and individuals would be attracted by the potential for the delivery of retrofit schemes of works, when considering the burgeoning nature of the retrofit market, and the high levels of inefficiency within the

building stock (DECC, 2010a; Killip, 2012; O'Keeffe et al., 2016). This concept is indicated by the following statement;

> *'The market is quickest growing within the UK, now admittedly the UK is very far behind, but nevertheless it shows that there is the potential within the UK to deliver great things.' (RG11).*

It is also considered possible that the drive of larger businesses to create economies of scale, could increase their market share via the application of supply, or installation operations. This was stated as a route to enable reductions in unit prices of projects, along with the development of products and methods of completing works in an ever more efficient manner (Fawcett et al, 2014). This was one particular concept highlighted between the UK and German nations, the concept that a 'tried and tested' formula could be 'imported' to enable businesses to upscale operations at a fast rate, to ensure high process efficiency (Dowson et al., 2012). On this note however, it is also highlighted that this type of blueprint import needs to be joined by a high level of tailoring to ensure that activities are suited to the UK's case. This emphasis upon exporting German products and services is highlighted by the following statement:

> *'I am now also looking more at the supply chain side of things and promoting the establishment of a network of green businesses and working to get more exporting of German products in particular promoting the type of architectural, and engineering practices we have in Germany more widely, in the main to aid the growth of the green product supply sector.'* (RG7).

Alongside this sharing of products and concepts across borders, another concept which is suggested to emerge is that of the increased variation of business type within the sector, encouraging the establishment of partnerships and potentially cooperatives, to enable resource pooling (Fawcett et al, 2014). This is believed to be a valuable way in which to overcome the downfalls of the sub-contracting model and to also increase the sharing of specialist knowledge to deal with different project intricacies. An embryonic co-op style operation indicated this with the following statement:

> *'People get a choice as to who out of the co-op carries out the work. Plus because it is a tender process, it is competitive, meaning people see it as a shrewd investment and they are getting a good deal. We are also adding that little bit of extra service in*

the form of offering a style of project management which takes the emphasis away from the homeowner doing everything. So we give them advice on planning and things.' (R8).

Therefore, as distinct businesses and retrofit operations pool efforts and resources, it is anticipated that innovative business and delivery models are expected to emerge. This joining together of sector companies, means the downfalls of operating singular or multiple profit centres can be overcome, with the added benefit of operating with other quality businesses, ensuring positive reputation establishment (Fawcett et al, 2014).

6.2 Anticipated policy/sector interactions

Within this subsection an assessment will take place of how the EERS sector and the UK's retrofit policy landscape will evolve into the future. This is carried out by evaluating insights by the EERS sector population sampled here, and their experiences of past and present policy interactions. As suggested within the results section, the growth of the retrofit market and customer bases is the responsibility of both policy and also the EERS sector itself, therefore sector practitioners have significant causal influence upon the growth of retrofit. However, it is also appreciated that policy mechanisms to attract end users to retrofit are very important, with the belief from respondents that the potential customer base could be improved via policy environment enhancements (Dowson et al., 2012; Gooding and Gul 2014). This concept of policy intervention requirements is identified via this statement:

'Only early adopters are going to stump up money, meaning the market place is very small. Therefore the retrofit industry will only survive via government intervention.' (R3).

However, there was also the school of thought amongst respondents which suggested that policy incentives were ineffective in creating long lasting change to the retrofit discourse, and therefore the EERS sector in the main is solely responsible for enduring positive change (Rosenow and Eyre, 2016). This standpoint is shown by the following statement;

'I think that the ones who are doing the best jobs are operating outside of the policy areas, acting on their own completing jobs to a high standard. I think you have to look at their business model and what their key concerns are and then create policy which works with those.' (R9).

Appreciating the variety of different interview responses regarding the future of policy and EERS sector relationship, the following sections now assess how different key aspects of the UK retrofit situation could change moving into the future.

6.2.1 The EERS sector and the low carbon agenda

Firstly within this section an examination of how the EERS sector runs in parallel with the low carbon agenda within the UK takes place.

It is anticipated that due to the multiple downsides of carbon intensive practices, (i.e. negative climate impacts, energy security issues and an increasing unaffordability of energy) will remain and potentially worsen into the future, meaning that the pressures upon society to adopt increasing low carbon practices and ways of living will increase (Unruh, 2000). For instance property legislation will continue to be governed via policies which promote increasing sustainability, which could entail added renewable energy provision or indeed efficiency improvements (Geller et al., 2006; Murphy et al., 2012). Another case, may be an increased focus from policies prioritising the way in which innovations need to be emerging which enable a satisfaction of customer energy needs, with added sustainability, (e.g. smart building controls) (Darby, 2006). What these anticipated progressions within policy do indicate is an evolution towards an environment supportive of the EERS sector, with conditions steadily increasing to assist the sector in growth. This is the case for instance with the intentions of the GD in aiming to provide increased levels of finance to end users, enabling low carbon improvements to be linked to bills, and also to remove the debt from individuals and apply that negative to properties (Arie, 2012; Dowson et al., 2012; Rosenow and Eyre, 2012). Although ineffective, the overall intentions of the GD were in the favour of boosting the level of activity and profitability of the EERS sector. It is accepted here that the GD harboured the potential to open up a significant level of new business and opportunities for EERS sector practitioners to take advantage of (Marchand et al., 2015). In design, the GD policy route was heavily reliant upon the EERS sector taking the lead in delivering the policy scheme, and therefore from this, moving into the future it is clear that the sector will continue to take a lead in implementing policy (Rosenow and Eyre, 2015). This is due to the fact that, government finance levels to subsidize large scale housing stock improvements is insufficient to ensure large scale change. Plus, the experience the EERS sector now has carrying out policy related works is at a significant level, meaning a utilisation of this knowledge would be key in gaining retrofit activity increases.

From this, if the EERS sector does experience increased activity, due to assistance from the low carbon agenda, then it is proposed that an increase in the level of EERS sector population will result, this will further reduce the end user reliance upon carbon intensive strategies. What is important to note here additionally, is that in the case of climate change, the UK's EERS sector alone is unlikely to achieve any significant impact. However with a focus internationally upon the built environment, serious in-roads could be made to reduce the level of carbon emissions globally.

6.2.2 The EERS sector and innovations

The next area in which attention is needed to be paid to enable EERS sector evolution, is that of innovations. This theme has a central role within the data due to the high level of product supply practitioners within the sample, detailing the extent to which new products and processes are required into the future. Although it was stated that overall the influence of financial barriers is causing a limitation to the extent of new innovation uptake, there was also the reoccurring theme that with increased volume, affordability prevails (Calì et al., 2016; Koebel et al., 2003). Therefore, with the reduction in innovation costs, and an increase in technological capabilities, a reduction in the level of high capital cost risk, and an increase in the prevalence of different types of innovation prevails. With a boost in the level of innovations which are widely used, there is the potential for increased acceptability by end users and therefore with volume, a reduction in capital costs (Owen et al., 2014).

In the case of the GD, in its first guise, higher costs measures were prioritized, meaning a high level emphasis upon technologies such as external wall insulation (Rosenow and Eyre, 2012). However, with amendments, and calls from industry to permit a more holistic approach to tackling properties, different types of measures came to the fore (Rosenow and Eyre, 2016). Learning from this, the EERS sector along with policy makers need to work together to ensure the mainstreaming of many types of retrofit measures. As with the way the GD was altered via EERS sector calls for change, it is anticipated here that the direction of retrofit will be in some way governed by industry, with the emergence of different products and processes informed by live projects and sector strategies. Therefore this positive way in which the sector can aid innovation via working with policies encouraging new ways of operating is perpetual in increasing retrofit activity (figure 16).

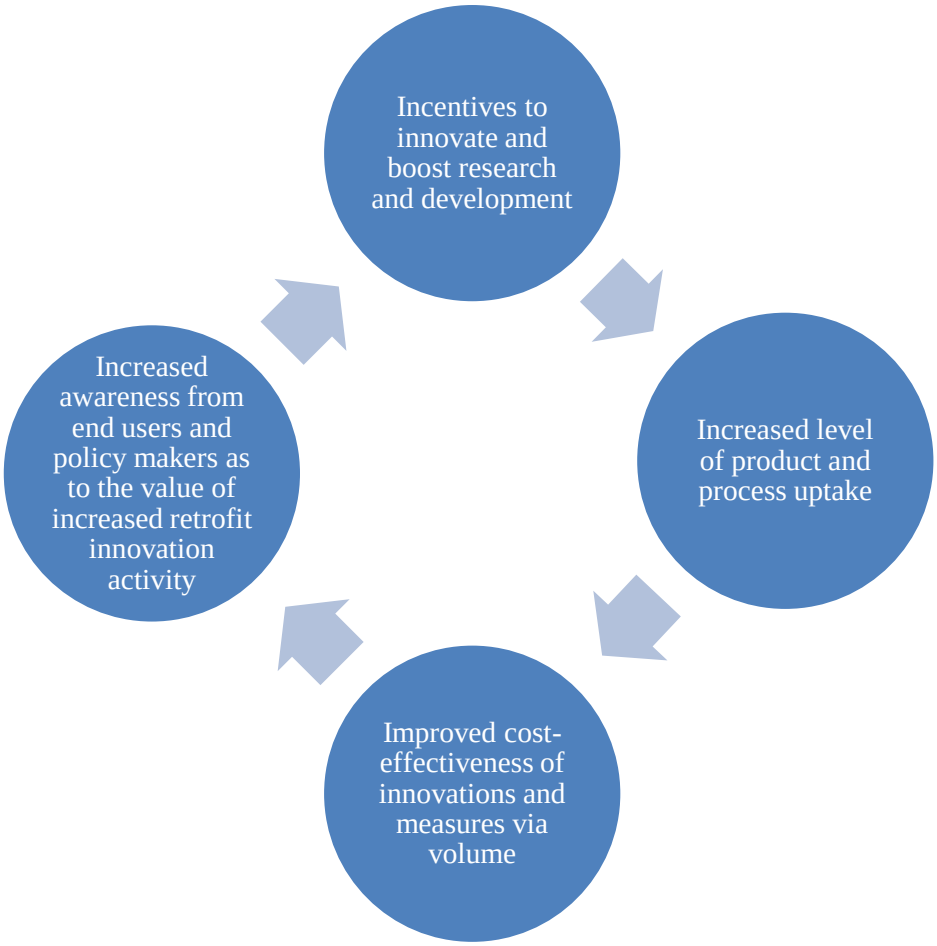

Figure 16: The positive feedback of innovation in enabling increased retrofit activity.

6.2.3 The EERS sector and end users

Although this research has been focused on the EERS sector and the experience practitioners have had attempting to produce added retrofit activity, participants did also have insight into operational methods of working with end users to enable the best outcome from retrofit schemes of works.

What was clear however from sector practitioners is that among the end users they have completed works for, an attitude of mitigating against carbon intensive behaviours, was prevalent. This trend of inefficiency in property energy usage is therefore predicted to be a growing driver in pushing end users to reduce their energy usage and bills. Related to this increased awareness of issues of energy use linked to increased energy costs, is the anticipated trend of retrofit activity becoming more mainstream, as awareness advances

occur, along with increased retrofit volume generating unit cost reductions (Cali et al., 2016; Dowson et al., 2012).

6.2.4 Summary of the EERS sector role in generating a low carbon society

Drawing from this chapter along with the results, this section relates to addressing the research objective of *Pinpointing of influential factors affecting the performance of policy and the UK's EERS sector.* It is important here to state that these suggestions of future conditions of the EERS sector and policy are made with indications of the sample here, and are appreciated to be unclear due to the complexity of the sector and policy. Moreover, it is acknowledged that multiple barriers still exist in hindering the uptake of retrofit activity (section 2.2.5).

Taking into account the different barriers (section 2.2.5) which the EERS sector interacts with, it is suggested that moving into the future, the operational conditions in which the EERS sector functions will improve; with increases in the level of work available and also expertise and products to complete work. This evolution is suggested to be largely attributable to aspects outside the direct operations of EERS sector businesses, such as climate change, financial pressure encouraging efficiency, increases in energy costs, and reductions in fossil fuel availability (Jaffe et al., 1999). However, alongside these aspects is the concept that EERS sector companies can also have a positive impact upon the situation. This is suggested to be enabled by a focusing on increasing end user awareness on the benefits of retrofit, boosting process efficiency and innovation usage to reduce project timescales, and also increased expertise levels to ensure accuracy in advice given to end users (Koh et al., 2012). In taking these concepts into account, it is anticipated that stable growth can be generated over a long period of time, which could also produce additional impacts upon the extent of low carbon practices in other areas of society such as transport and infrastructure (Eames et al., 2013).

6.3 Recommendations for retrofit activity growth, lessons from a German comparison

Throughout the data collection, the impact of policy upon the EERS sector and resultant retrofit activity was considered high. Consequently, the opportunity is taken to identify a variety of changes to the EERS sector and the UK's policy landscape which could assist in improving the operational environment, and to produce a sector which could play a more pivotal role in producing a low carbon society. These suggestions are linked to the barriers to

uptake as stated in section 2.3, and take influence from UK and German individual interviews, along with group interviews and focus groups.

6.3.1 Profit generation routes

Commercial models and methods of profit generation within the sampled group of UK and German EERS sector practitioners were different, both between participants, and also across the national borders. In general there was a specified trend from practitioners within Germany that due to the high level of expertise and experiential knowledge, EERS sector members can choose to take part in multiple areas of a project, thereby taking advantage of multiple profit centres.

The core reasons for this was due to the economic drivers of generating income, and also due to the methods in which tradespeople function and the standards of quality aimed for. This motivation to attain a high level of quality is stated to produce a cradle to grave attitude to projects, where in some cases it was considered that external tradespeople would not operate in similar sorts of ways. Consequently to control individuals operating on a project, means quality can be certain, and project management streamlined due to each person involved being aware of the levels of quality expected and also the timeframe to be worked to. Furthermore, the comprehensive service of retrofit providers is divergent between nations, from the perspective of project manager provision. There is more of a stated trend within in data that architects or retrofit designers are utilised more within the German context than that of the UK. This means in Germany there is prevalence for one point of contact bringing the project together and ensuring the level of quality aimed for is high enough. To achieve this, it was stated that a reliable network of practitioners is required to come together within a short timeframe to carry out a project. Overall, the German approach differs via its strategy of delivery, with businesses being much less fragmented than those operating within the UK, with companies working closely to generate multiple profit centres, under a project manager. This viewpoint is showed by this statement:

> *'For us personally, we pride ourselves on working with innovative materials and technology, which means I do spend a significant amount of time working with different businesses, I have created a network to complete work. And there are also the individuals I mentioned who work with us on a contracting basis.'* (RG2).

The fragmentation experienced in the UK is considered to be exacerbated by the prevalence of SMEs. Furthermore, due to the retrofit industry being less well established within the UK, when compared to Germany, the existence of high expertise retrofit managers established to coordinate a fragmented supply chain was absent, meaning that attaining a streamlined service was considered difficult, as shown by this interview extract;

'I think that the way in which the market is quite fragmented, means that for end users navigating through is quite complex.' (R11).

6.3.2 Quality Focus

Connected with the first point, the second area in which differences were identified between the UK and Germany is that of the quality levels endeavored for by EERS sector practitioners as standard. It was identified by UK participants that the key way in which businesses are run is to ensure that the profit line is healthy, as indicated by this statement:

> *'People want to save money more than anything on their property and tradespeople want to make money, so there is a bad dynamic between the two parties.'* (R11).

In contrast, within Germany, it was stated that to permit a more sustainable EERS sector there is a need for a move away from a simple viewpoint of the finances of business:

> *'It can't simply be a focus on the money and the fact that they want a quick buck, the focus must be on the quality and then they will earn the money automatically.'* (RG5).

Quality is a concept that is viewed as detached from a low cost scheme of works. It might be stated however that to sell a higher cost, higher quality retrofit project, there is the requirement of end users willing to spend the additional finance to facilitate a higher specification project. German respondents spoke of a motivation within their society to produce properties which have permanency and which remain within families, consequently meriting the extra finance to attain an increased level of quality and performance from tradespeople, technology and materials. Moreover, participants considered German trends of energy efficient appliances and products to be the norm, meaning that citizens are looking to attain a low carbon lifestyle generally. Within the UK, the opposite is suggested to be the case, where end users are not as aware of the requirement for energy efficiency and thus

prioritise other things, such as luxury fittings and carbon intensive appliances. Consequently from this the differences in societal needs are generating EERS sectors which are either flourishing or struggling in a fragmented manner.

6.3.3 Working above the minimum

Continuing with the move away from pure financial influences governing schemes of works, another difference between respondents from the two nations was the standpoints in which sector practitioners viewed the legislation they have to operate within. The perceived trend within the German model for instance was one of looking more into the properties building physics and not simply the regulation minimum levels. German respondents considered building regulations to be overly crude to permit the accounting of retrofit project intricacies. Reasoning behind this was detailed via different influences; firstly the level of training and capability of sector practitioners meant that properties could be tackled in a tailored manner rather than simply a broad brush building regulation method. This means that ventilation could be specifically managed within bathrooms for instance, which produces a healthier air quality indoors than that stipulated by general building regulations. Secondly, the implementation of standards such as Passivhaus level construction was stated as more common place within Germany meaning prevalence for standard buildings to achieve superior levels is more widespread. Subsequently, end users are prepared to invest in higher quality retrofit schemes due to Passivhaus and other high performance properties being more well known, and also more practitioners are capable of delivering a retrofit to a level such as Enerphit (Fawcett et al., 2013), which is the retrofit Passivhaus standard;

> *'In Germany, people want to build something of quality, which is as good as possible, no focusing on cost. So the awareness of the end user is completely different, they know what goes into a house, and what technology is out there. Customer demand is much higher, which means that the industry is geared up for it. That is why passive standard homes are more common in Germany.'* (RG10)

To enable this higher level of retrofit quality more than half of German based EERS sector respondents believed building processes should be assessed at regular intervals to ensure that high levels of energy efficiency are going to be generated. This strategy aims at eliminating the performance gap which limits the potential energy savings possible. This rhetoric was the

opposite of what UK EERS sector participants were stating. In their case intermediate checks to retrofit works were not sufficient in frequency meaning that in some cases amendments had to be carried out after work had been completed, incurring expensive costs to both EERS sector practitioners and end users.

The difference between the UK and Germany in working towards levels higher than minimum regulations is evidently both a supply chain and end user issues, but nevertheless the difference is stark and without a policy and EERS sector structure to minimize that difference, the issue will prevail.

6.4 Areas for improvement

Advancing forward the areas where EERS sectors within the UK and Germany are responding to retrofit at scale challenges, the following areas are specific themes which are considered areas for improvement to permit greater UK retrofit levels.

6.4.1 Joined up implementation structure

To facilitate a retrofit level increase, one standpoint held by UK sector practitioners is to boost the level of service obtainable by end users, therefore taking a step away from a subcontracting route, which risks losing customers due to quality issues and projects becoming protracted. One line of thought stated by participants would be to improve the organization and management of retrofit delivery; to ensure the different parties involved are working together, via one central point of contact. This is deemed to create an environment where customers receive the best service possible.

6.4.2 Training provision increases

The concept of customer service levels was reoccurring within the data as an aspect respondents viewed as important, and in particular the need for training via apprentiships, and the formulation of a bank of time served practitioners. It was suggested that by this time served emphasis, other trades and project managers would be willing to take practitioners onto a project as they would have confidence in their skills. This need for increased training

was deliberated in terms of enabling quality and also progression within the sector as indicated by these statements:

> *'The first thing that needs to happen is bring all practitioners up to a high level whereby every contact an end user has with a retrofit industry individual is one of professionalism and knowledgeability.'* (R7).

> *'In comparison to Germany the training programmes on offer in the UK are very crude and do not enable trainees to pass above the standard building regs, so that means that people wishing to progress within the industry and enable innovation are going to find that difficult.'* (RG10).

Moreover, it was suggested that without this level trust and proof of expertise then the formation of networks is unlikely to happen, this is due to the fact people are reluctant to work with unproven or unaccredited individuals. This requirement for higher standards was also stated to be more wide reaching than purely the construction site. Additional networks were considered to include the people designing and businesses supplying materials; all stakeholders included in the life cycle of a building. So from this perspective there needs to be policies which offer an overarching view of the retrofit industry, which discourages carbon intensive practices at all stages of the retrofit process.

6.4.3 Innovation fast-tracking

The notion of fostering networks of businesses which contain practitioners all working towards similar goals was also considered as important when viewing the emergence of innovations.

One key area divergent between the UK and Germany, is that within Germany and on the continent, the supply of building materials occurs via large buying groups instead of smaller companies as happens in the UK. This means in Germany, the price for materials or products is set by the buying group. These large national companies can bring innovations forward comparatively quickly, due to the low number of supply chain individuals, and the support of a significant budgets for development and promotion. This is in contrast to the UK where there is the suggestion that many smaller innovators and businesses attempt to bring forward new innovations. These smaller companies are restricted in comparison to larger outfits, in

terms of finance and human resources, meaning the rates of innovation diffusion into the market are considered slower. Subsequently in the UK, it was identified that retrofit product supply needs a higher degree of invention within the way a business functions, and also the utilisation of networks and other outlets to gain a competitive advantage over established suppliers. This concept is shown by this statement:

> *'In the UK overall innovations are brought forward in dribs and drabs, someone grabs hold of something and tries to push it out in their own way, if that is one of the big boys then that can be quite successful in getting the geographic coverage, but if it is a smaller operation then it can be a slow process.'* (RG3).

6.4.4 Public Relations

The EERS sector's customer facing element is also a part where attention is deemed to be required, to permit retrofit at scale. Participants stated a requirement for an alteration in how retrofit is conveyed to the average home owner or prospective client. The present strategies in place show only minimal marketing occurs within the UK for high quality energy efficient goods, in contrast to Germany where higher rates of promotion occurs for products, due to competition between suppliers. This is suggested to be due to the larger size of the market and also the higher societal awareness of quality and energy efficiency. This theme is indicated by the following statements:

> *'In the UK we actually do very little marketing work, because overall we have found that house builders in general are simply working to price and to the minimum standard they can get away with, meaning most trade comes from those individuals searching us out.'* (RG10).

> *'In Germany, people want to build something of quality, which is as good as possible. So the awareness of the end user is completely different, they know what goes into a house, and what technology is out there. The customer demand is therefore much higher, which in turn means that the industry is geared up for it.'* (RG10).

As a result, one stated method to encourage public relations and end user awareness is to improve the level of retrofit works with more mainstream construction activities, such as kitchen and bathrooms upgrades. This suggestion for improved UK public relations emerged due to the Germany strategy being very inclusive of carbon saving within all types of

property upgrades. Alongside this high level of demand for the EERS sector within Germany, is also the fact that German incentives encourage low carbon retrofit, pushing further the level of work and requirements of businesses. From the industry perspective therefore a striving to work with government assistance, in a more integrated way is needed, to ensure effective working between trades, and also increased quality and the rate in which innovations arrive in the market.

6.5 Suggestions for policy changes

Employing the data areas covering the manner in which UK and German EERS sectors have responded to the challenge of creating large increases in retrofit activity, the following points were advocated as methods in which policies could be developed.

6.5.1 Flexibility in finance provision

The first recommended area for policy development is the manner in which finance is offered to retrofit schemes of works. German participants agreed that the high level of finance flexibility within their nation is deemed fit to complete a successful retrofit project. The supply chain consequently has the option to tailor its offering to end users.

In the UK case, individuals felt that this ability to source finance for different types of end user was absent, and the directing of finance to different areas of society was a concept in need of development. It was suggested by participants, that with finance directed at generating an initial number of retrofit grants, an increase in EERS sector activity could be produced, which in turn could enable the commencement of economies of scale growth. With this increased competition it was also thought that this finance could have non-geographically specific employment growth impacts, as suggested by the following statement:

> *'There needs to be a quest to have an intelligent input of money, in key places where it will have the most impact, not just in a monetary way, but wider than that, in a long term skill, jobs, innovation, technology kind of way too.'* (R8).

6.5.2 Policy movement alongside innovations

The second proposed area for policy alterations is a requirement for policy to move swiftly and more comprehensively to absorb new innovative products. This focus originated from the

need to have regulations prioritising building physics, instead of simply general standard building regulations. This recommendation to focus on building fabric is emergent due to a stated confusion as to why UK projects were measured as to their success with regards to renewables, or to the level at which projects enabled bicycle storage, for instance. A move away from this to a policy which prioritises materials and building envelopes was instead suggested, that way an efficient building was stated to be able to make best use of renewables, instead of the risk of renewables only mitigating against an inefficient building. This concept is indicated by the following statement;

> *'In Germany focus is first and foremost on materials, whereas in the UK, the focus is more dilute, looking at materials, renewables and transport for instance. If there is more attention given to renewables, than for the envelope, it simply drives the renewables up and not the building materials. If my renewables don't work, I still have an inefficient building, whereas if my house is efficient, renewable don't matter as much.'* (RG5).

6.5.3 Comprehensive training strategies

The third area proposed for policy development is to address the extent of training available for practitioners. Participants suggested that the German strategy to generate construction sector time served apprentiships, to enable the EERS sector to achieve high quality standards is a positive route to replicate. The time served aspect of this training type was specified as the key reason for the high performance and quality standard of building professionals within Germany, along with the industry being seen as a respectable career prospect. Plus, it was suggested that higher qualified tradespeople can tackle significant levels of project complexity. This means that project timescales do not become protracted due to subcontracted trades being brought to projects to deal with specialist requirements. It was detailed by multiple research participants that the trend for UK retrofit practitioners to focus on carrying out one particular aspect of retrofit, has caused an obstruction in the rate of sector advancement. Therefore an in-depth training scheme which is accredited for retrofit and recognized widely would be valuable in the UK. This sentiment is indicated by these statements;

> *'It starts at the bottom, to do with the apprentiships, because in Germany, you become a tradesman through apprentiships schemes. If you have not gone through the*

scheme, you would not earn the money, therefore upskilling and good tradespeople are areas which is lacking in the UK.' (RG5)

'Practitioners in German work to a higher accreditation level, *because it is a requirement of the industry that people must complete time served apprenticeships in multiple areas, producing a craftsperson, not just a tradesperson.'* (RG10).

Connected to this above point concerning higher qualifications to deal with the complex aspects of retrofit schemes of works, is the need for a significant number of retrofit project managers to drive a project capably from start to finish. This manager role is deemed as a good way in which to assist those end users in making decisions regarding a retrofit project, and to provide clarity as to how the sector can assist them. This training of practitioners to be able to manage projects is also suggested to bring together practitioner networks. This network creation via a gatekeeper manager or power fulcra as specified by stakeholder theory, is deemed very important, as it has the potential for streamlining of delivery, increased levels of process efficiency, and ultimately boosts the level of appeal for end users to employ the sector.

6.5.4 EERS sector accreditation and assessment

The concept of increased training and accreditation for quality purposes leads onto the theme of assessment for both the EERS sector and resultant projects which are produced. It was suggested that aside from accreditation, there needs to be an increased level at which policy implementation supply chain businesses are checked, to ensure that they are capable of policy delivery to the correct level. This viewpoint is resultant from the view that some businesses felt their good reputation was been tarnished due to other businesses representing the sector in a poor manner. This was particularly in reference to the GD Orb online database, which due to a lack of vetting of businesses contained a high number of outfits which were reluctant to place the customer first. Therefore some participants considered the establishment of a quality onsite resource, or a one stop shop for people considering retrofit, would be valuable. In particular this resource was suggested to comprise businesses who are accredited as high performance, high quality outfits, focused on customer service. Plus, from this website, navigation to pull together individuals to lead the project and carry out the supply and installation for instance, should be straight forward for members of the public with even minimal computer literacy. This would thereby open up the option to clients, and move away

from the situation where households may be taken in by unscrupulous businesses due to the fact they are unaware of other options. This concept is show by this statement:

> *'Now in my mind there needs a one stop shop for retrofit advice, technology, materials and quotes. Without this we are still going to be relying on members of the public to pull together complex implementation and delivery chains which simply is not going to happen.'* (R5).

In addition to the assessment of businesses, it was also felt that the assessment of properties needed to be increased, to ensure that sector companies were highly informed as to want measures and processes were best suited to the project. In the main, this opinion emerged due to a lack of confidence within the Standard Assessment Procedure (SAP), which was used to calculate the performance of properties under the GD. It was considered by multiple practitioners that this method of assessment did not offer the sort of in depth data on a property which would result in an informed knowledge on concepts such as air flow and moisture levels.

6.5.5 EERS sector interaction with policymakers

The next area considered an aspect in need to addressing to alter the performance of policy was that of businesses direct interaction with policy and policymakers. From the perspective of compliance it was considered that under the GD the level of resources required, particularly from SMEs, was too high to ensure due diligence. Therefore, respondents called for a better balance between the levels of red tape needed to ensure compliance of process and client protection, but also some freedom, to complete individual project in a more tailored manner. This attitude was considered important to enable increased streamlining of project and in turn added attractiveness of retrofit.

Alongside improved levels of administration requirements of implementation businesses, is a stated need for increased levels of dialogue between EERS sector practitioners and policy makers was apparent. The limited level of warning given to operational changes and levels of funding available under the GD and the Energy Company Obligation was the key driver of this suggestion. These unforeseen changes provided levels of uncertainty that many businesses found too high to be able to work within sustainably. Thus, respondents specified a need for increased communication with policy makers at both the policy making and policy administering stages of retrofit.

This increased level of communication with policy makers, links in which the following area in which policy could look at moving forward. This area is the establishment of a long term style of operating between policy and the EERS sector. All respondents considered that the fact policy had been to an extent uncertain under the GD, meant that to enable an increased level of investment, a much more long term view of operating is required.

This longer term strategy was stated as being preferred for the following reasons (figure 17):

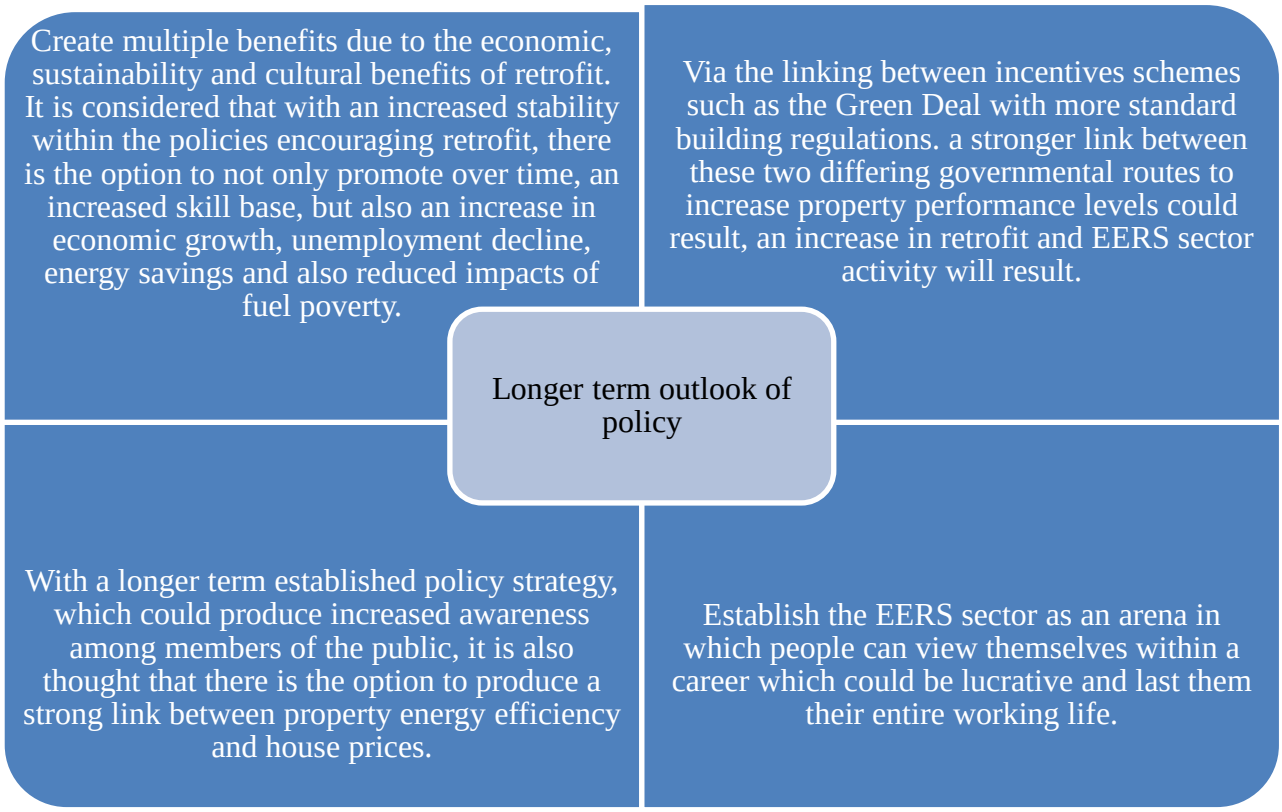

Figure 17: Advantages of operating a longer term outlook for policy.

6.6 Resultant requirements of business

Linked in with the above selection of routes forward for policy, this section completes the circle by assessing the requirements of businesses to work with improved policy schemes to increase retrofit activity and professionalism.

These requirements of the EERS sector are split into four different categories:

- Training
- Strategy
- Innovation
- Customer focus

6.6.1. EERS sector business training

Training was stated as a priority for businesses to work to higher performing sector ability. This priority was split into different types of requirements.

First, increased business management and marketing skills are required due to the unprecedented nature in which the GD relied upon retrofit businesses, for promotion and finance. It is considered that due to the removal of significant government financial assistance within the GD, this type of strategy is here to stay. Thus, into the future the expectations of businesses will remain high and operational strategies of retrofit supply chain companies need to evolve to cope with this policy strategy.

It was considered that within the GD, the emphasis upon EERS sector business capabilities was very high, with the need for businesses to market their products and services at a high professional level from the outset. The lack of ability within the sector was considered one reason as to why the GD did not produce large scale activity. From this, businesses need to train individuals in the skills required to produce professional high quality marketing and advertisement schemes, along with business skills to successfully manage a business and produce a strong positive reputation.

In addition to internal skills increases, there also needs to be improved levels of business advisors operating in the sector, to implement expertise in more general business aspects, including access to capital for growth, retention of customers, operation efficiency and niche identification. Without this input of experiential knowledge the rapid increase in sector capability will not result.

Increased levels of knowledge and training were also deemed a necessity in terms of ensuring the management of projects. In terms of guaranteeing added quality and project performance levels, it was believed important to implement retrofit project managers within schemes, to

make sure that all supplies, trades, and processes are right. With an increased in higher performing properties, this concept was deemed even more important as onsite technical knowledge is required continuously to ensure that projects achieve a quality finish. This concept is particularly true for ensuring a property achieves a high level of airtightness for instance, as trades need to work together to make sure junctions and the way materials work together is implemented precisely.

Due to this increase in performance, training was deemed insufficient at the moment to enable practitioners to be able to produce schemes which were tailored to the particular property characteristics and building physics.

6.6.2 Business strategy

The first area of business strategy modification which has been suggested by participants as a method of increasing capabilities is to look outside the route of simply producing property minimum standards.

The reasoning for this was supplied via multiple points;

- In not simply working to the minimum, businesses have the opportunity to offer additional services and products which can increase the number of profit centres they are working with. This creates an environment whereby companies have the option to expand their offering, and also generate greater levels of business and retrofit activity, along with providing a deeper retrofit which saves the client more in terms of carbon and energy costs.

- Also via the provision of additional services, EERS sector businesses can offer a future proofing of properties. This means that not only will properties be energy efficient by today's standard, but also by the standards of tomorrow.

- Another aspect related to the need to operate outside policy, is for the need of added long term security. It was a reoccurring theme that overall the GD had produced a market which was defined as being uncertain. This lack of stability formed a key reason why many practitioners selected a route which involved trading outside of policy.

The second area of business strategy in need of alteration is that of operating within networks to ensure projects can be dealt with professionally.

The following points were offered as reasons to increase network presence within the sector;

- Increased working within networks is important to provide an evolution forward for the industry, to move away from the restricted nature of working within singular businesses, where only individual projects can be undertaken. With improved networks, it is deemed possible to not only tackle larger projects, but also complete project in a time efficient manner due to the different types of skills within networks.

- Moreover, networks are stated as a good way in which to bring additional work to businesses, sharing trade therefore limiting the negative impact of the present fragmented nature of the market.

- Lastly, networks were also stated as being important due to the way in which they attract more traditional practitioners into the sector. Even though the data shows lots of different suggestions in ways to move the sector forwards there was also the acknowledgement that to really produce quality projects, high performance general trades such as carpenters and plumbers are needed to ensure finishes and building structural aspects are taken care of.

The third area suggested as an amendment for business strategy to enable increased retrofit activity, is the ability for business to remain adaptable and flexible to the demands of the market. This is of particular significant here as the important of remaining flexible was reoccurring in relation to the demands of policy, regulation and customers. Plus, linked in with the concept of adaptability is the need to continually promote increased streamlining of businesses operations, to ensure that processes are as efficient as possible, and use the least amount of resources and time to complete. With this efficiency there is the ability to change or alter processes swiftly.

6.6.3 Customer focus

The fourth area in which business strategy attention is needed is in how practitioners interact with customers. Into the future, for additional levels of trade to occur, there needs to be improved focus on quality and the ways in which client bases are built. It was considered by the majority of participants that a move away from the failing customer interaction methods, such as door-knocking is needed. Instead a route of high professionalism is required. This route is deemed particularly important when considering the need for deeper and deeper retrofits to take place in the future, to enable increased carbon savings, linked to more

stringent policies. To ensure that these deeper schemes are carried out professionally, enhanced client relations are required to produce a project which works in the manner in which the occupants live.

6.6.4 Innovation

The last area of required strategy enhancement is that of innovations. In a sector which is driven by requirements from policy and end users, and also via the need to provide solutions to many different types of properties, innovation levels need to be high. Without an adequate level of innovation there is a risk that properties will be retrofitted in a manner which does not accurately suit the building or occupants, and therefore suboptimal in its carbon and energy saving rates. To address this, themes in the data called for innovations to be adopted into the sector and adopted into supply chain stock, in a timely manner. Furthermore, this adoption into the supply was suggested to be required at a significant scale, to ensure new emergent product are competitive in terms of cost when compared to more traditional or established solutions. The notion of swift adoption of measures was also requested to extend to smart technology and the route of automation of installed technology in particular, to ensure that properties can be managed effectively as soon as possible without the necessity to provide extensive levels of education to homeowners or tenants.

6.7 Chapter Summary

Within this chapter an application of the data collected from semi structured individual interviews, group interviews and focus groups has been made to join together varying viewpoints of how the sector should develop and to distil ideas down. There is the broad expectation that overall the EERS sector will gain wider scale uptake into the future, and therefore have the capacity for greater influence upon policy routes and the progression of retrofit innovation and expertise routes. This pathway to improve the capability of the sector is deemed crucial to ensure that individuals within the sector can deliver retrofit schemes to a high quality level efficiently, and that this efficiency has the ability to absorb innovations and create a sector capable of producing well managed, affordable, attractive schemes of works. The broader implications of the work are described in the next chapter.

Chapter 7. Conclusions and policy implications

In undertaking this research, factors hindering EERS sector success and also factors which have the potential to aid sector development have been illuminated. To enable this a qualitative technique based study was used to gain insight via UK and German based individual interviews and UK group interviews and focus groups. This conclusion chapter highlights areas whereby if the EERS sector is going to succeed in generating green growth, and produce a retrofit sector capable of high levels of activity, change is required:

- Firstly, the business propositions EERS sector members are providing need to appeal and be attractive to customers external to any government subsidy. To enable this, enhanced levels of training, professionalism and marketing are needed, to position the sector and its business offering in an appealing light to all types of property owners or tenants.
- From the perspective of society a merging of purchase habits and types is required. This is in particular reference to the way in which products, such as white goods are graded in terms of energy efficiency. This attitude to aspire to high performance products needs to expand to include wider property considerations, and home improvements. Thereby making energy efficiency the norm; an aspirational concept.
- EERS sector operations also need to be improved, by increased training levels making the prospect of working within the industry a career long possibility, with high levels of professional development possible. The recruitment of well qualified individuals in the sector could in turn increase the level of professionalism, effective project delivery and process efficiency, and stepping away from subcontracted services. Combined, this would further enhance the appeal to consumers of having retrofit works carried out.

7.1 Fulfilling the research aim and objectives

Taking the initial research questions, aims and objectives as presented in section 1, the following are answers and evidence provided by the research which attempts to address these questions.

The primary aim of this thesis was **to contribute to the existing knowledge base of learning from on the ground EERS sector practitioners, to create policy conditions to minimize barriers to growth**. This was achieved via an investigation in the present

formation of the UK EERS sector, along with their views and opinions on working towards increased retrofit rates, alongside policy incentive schemes. The overarching motivation was to generate an increased level of understanding as to how the supply chain and policy makers could best operate together to minimise the negative impact of the energy efficiency gap.

These following discussions highlight how the research has attempted to answer the research questions (section 1.1) and related aims (section 1.2).

Q1: What policy strategy needs to be implemented to optimise private sector businesses to enable large scale increases in domestic retrofit activity?

(Objective: To assess the performance of the UK's and Germany's policy landscapes, and the exact outcomes of policy mechanisms.)

From this research assessing the role of EERS sectors in both the UK and Germany, it can be seen that UK practitioners are aware of the ways in which the sector needs to evolve, and the successes of the German sector are in line with what aims and improvement UK respondents have in mind. Therefore from this it can be appreciated that there is a pathway derivable from the German model, which is centred on the concept of high quality professional work and also high level regulations to push forward the performance of the sectors, along with installed materials and technologies. These regulations need to adopt a more specific stance with regards to how the building physics work on a property, creating a way to reduce the performance gap and also ensure the health of the property and occupants.

Furthermore, findings suggest that changes need to be made to the ways in which the end user interacts with the sector and also the sector approaches members of the public. Consequently, within policy alterations to encourage awareness amongst the general public, a higher performing EERS sector will still struggle to gain high levels of business. Therefore, businesses need to focus in on how they are being perceived by end users and also how they can get their service and products in front of end users in a professional manner. Training has been a major area in which respondents suggest improvements are needed, therefore to increase training to enable heightened customer service is one way in which the sector will be seen to be more viable, as a way in which to alter properties and provide comfort and financial benefits to the end user.

From a financing perspective, it is still considered that government assistance is required to enable EERS sector growth, and the consensus is that finance needs to be made widely available and flexible to enable the treatment of different types of housing stocks and also to ensure that the end user receives the types of improvements that work for them. In addition, finance or incentives need to be made available to EERS sector business to enable enhancing training as suggested above, or fast tracking of product or process efficiency.

Overall, the UK's EERS sector is in need of enhanced capabilities, in terms of physical capacity, skill bases and also technical ability. With a policy focus on these areas, professionalism and the adaptability of practitioners to deal with varying project types will emerge. Feedback from German participants, also suggests that although they considered themselves at a more progressive position than their UK counterparts, there is still room for improvement, with continuing advancements in training and innovations, pushed forward by policy and industry cooperation.

Q2: How can the retrofit supply chain be best configured to increase capacity and capability?

(Objectives: 'To assess how the EERS sector and related government policies attempt to boost EERS sector activity', and 'to pinpoint influential factors affecting the performance of policy and the EERS sector.')

EERS sector characterisation displays the complexity of different operational businesses. Commercial strategies range from singular measure policy implementation through to deep retrofit provision external to retrofit policy. Furthermore, business to business companies are varied, with retrofit implementation requiring significant upstream input. What is more, SME involvement within the sector is significant, meaning a focus on returning custom and completing work in a flexible manner. This complexity is exacerbated by different client types, including those retrofitting due to personal interest or policy fund utilisation. Within these businesses, quality has been stated as the main focus for success, via the removal of outdated customer acquisition techniques, and the establishment of high professionalism and training, to complete retrofit in a precise and timely manner. This

added quality, in turn required the reduction in reliance upon sub-contractors to complete significant amounts of a project, and in turn an increase in project sharing or cooperative working is necessary. In retaining operations internally within a business or group of companies, instead of subcontracting out, does however require increased levels of effective financial management and operational leanness. With this management, the ability to complete business via multiple profit centres effectively was also suggested as possible.

Q3: What lessons can be learnt from recent policy mechanisms to limit the negative impacts of the gap between potential energy efficiency and achieved efficiency levels?

- ***Objectives: 'To assess the performance of the UK's and Germany's policy landscapes, and the exact outcomes of policy mechanisms', and 'to pinpoint influential factors affecting the performance of policy and the EERS sector.'***

  Private industry expectations within the GD were high, with the industry needing to generate its own leads and provide a growing market. The policy in its intentions encompassed the needs of both private business and end users, via this strategy due to the potential for substantial competition driving down costs, yet with profit margins remaining. However, due to the lack of obligation or regulation, along with minimal government financial aid, high levels of information provision and private finance did not materialise. Therefore moving forward an obligatory aspect of policy is an important factor, which in turn enables deeper retrofit projects, with take into account how building physics operate and how different measures interact with each other. Therefore an emphasis on the long term impact of a retrofit project is required. This focus on linking property to occupants highlights the need to place as much importance on the EERS sector ability to install and provide quality retrofit as educating and increasing awareness and public knowledge. In the case of the GD, attention is clearly required in viewing how different policy tools interact with and impact supply chains and end users from different angles. Adopting this standpoint could enable a smooth customer journey to increase energy efficiency and enable a heightened level of awareness.

Q4: What strategies are emergent from on the ground retrofit supply chain practitioners to break down barriers to retrofit?

(Objective: To pinpoint influential factors affecting the performance of policy and the EERS sector.)

Emergent strategies which could be utilised into the future more widely to tackle the need for retrofit increases include:

- Focus on quality and rigour across different retrofit activities to establish positive business reputations and limit exposure to industry changes.
- Quality focus, also providing a future-proofing of properties, adding to the level of attractiveness of the investment prospect of retrofit.
- High degree of effective and efficient financial management and leanness of delivery to provide retrofit at competitive prices, whilst maintaining business profitability and employment opportunities. This leanness in turn relates to possible bundling of projects to in turn reduce per unit input and cost.
- Step away from sub-contracting required, and instead a move to involve more specialist collaborate working and cooperative operations, permitting high levels of quality and expertise on a project, and to provide flexibility to the intricacies of different schemes of work.
- Move away from reliance upon policy incentive and schemes to boost retrofit progress. Business strategies need to operate outside of boom or bust mechanisms to ensure high levels of long term stability and growth. However, alongside this is the fact that overall any policy implementation work does need to be accompanied by high levels of knowledge regarding the policy, incentives, and the implications of taking advantage of any fund.
- Increased policy interaction from businesses to enable retrofit to take a position within the low carbon agenda, and form a key component in producing Green Growth.

- Thinking internationally opens up opportunities to obtain knowledge and innovation from around the globe, accessing a wider range of cutting edge retrofit solutions.
- Focus on providing energy efficient improvements alongside standard property upgrades such as kitchen or bathroom enhancements. In doing so, energy efficiency is pushed further into the mainstream.
- Focus on training to ensure expertise levels on site are high, reducing the risk of issues protracting project timescales.
- Businesses involved in innovation production, needs to ensure high levels of accessibility to policy makers, to guarantee any alteration in product provision is adopted into a policy structure swiftly.

7.2 This research within wider academia

This section provides insight into how findings have broader implications, and are positioned within existing discourses. The relating of research findings back to the wider literature and themes, positions this research within the on-going debate, and magnifies the overall contribution of the findings here.

7.2.1 Contributed areas of research

This section is divided into three areas, each outlining the influence this research is considered to have made to the areas of: retrofit industry and related policy enabling ***market and technological developments***, ***network growth***, ***learning procedures*** and also ***cost and transaction improvements***; how stakeholder theory and transaction cost analysis can aid the understanding of the EERS sector and related policy; what policy learning can take place across national borders; and also the role of retrofit to enable green growth.

EERS sector business and policy ability to improve retrofit levels

Contribution 1: This research produces an analysis of EERS sector business activities examining how the variety of different populations aim to produce increased levels of carbon savings, inside and outside policy schemes. Key results highlight the role of the standard construction industry in completing retrofit works alongside specialist EERS sector practitioners.

This research brings together the foundations of stakeholders and transaction cost analysis and the role in which these businesses within the EERS sector interact with policy. Via this route, this research offers an integrated framework of analysis (section 3.2) aimed at examining not only the evolution of the EERS sector and business routes utilised, but also the relationship these businesses are having, and have had with policy, and the impacts this interaction produced. Subsequently, this approach has been used to attempt to improve the level of understanding of how different strategies need to be employed to increase EERS sector capabilities.

Therefore, a central contribution of this research is the bridging of the gap between policy aims and actual EERS sector results, and this in turn provides suggestions as to future pathways of domestic retrofit delivery chains.

What is considered important is that this framework to assess sector and related policy mechanisms has been developed utilising a conceptual framework aimed at understanding multiple aspects (section 3.2). Therefore this is considered suitable for other researchers examining the role of businesses implementing public policies, both in the context of carbon savings and in more mainstream arenas. Moreover, this research uses a methodology which has also been developed and implemented to apply this framework, which could also be utilised in other research areas. This has generated a focus to provide high levels of clarity, along with rigorous research into strategies to assess the retrofit situation, and the varying aspects affecting its growth.

Contribution 2: This thesis highlights the vital role in which policy incentive schemes need to focus on producing a financially sustainable industry, alongwith generating developments in market and technology conditions, network capabilities, processes of learning, and a reduction in the negative impacts of TCs. What is evident from the findings here is that practitioners require multiple policy schemes to achieve sector growth, due to the margin financial benefits of the Green Deal resulted in a boom and bust attitude to business.

By applying the research framework which focuses on assessing the EERS sector and related policy in as wide a context as possible, a high level of understanding is considered to have resulted in detailing how businesses presently operate, and what routes could be employed into the future. This is of particular importance, when it is considered that, in a period of policy design post GD, understanding the exact drivers and aspects of the EERS sector is of particular importance, as it has the potential to produce policies which are well tailored to

how the sector operates. What is considered of particular note is that via the literature review the factors influencing the EERS sector are wide ranging, and produce characteristically discrete business and operational models within the sector. This wide range of sector business and practitioner types means that within this research, operating via grounded theory is considered highly important as it offers the opportunity to let findings govern the research route. This research indicates that policies need to adopt a highly adaptable and flexible mind-set to effectively tackle the variances within the housing stock as well as the EERS sector delivery network. Although outside of this research, this variance in types of individuals and buildings obviously also continues into the realm of customer and end user, meaning that tailoring and flexibility are also required to ensure the best provision of resources to different clients. What is resultant here however, is the emphasis of businesses to have the ability to not adopt a locked-in attitude to methods of working and customer groups, and instead view the task of boosting retrofit activity, as an opportunity to increase process efficiency and leanness when applying a tailored set of solutions to a project. This leanness is emphasised due to its ability to improve market conditions, innovation diffusion rates, network interaction, and rates of practitioner learning, along with a streamlining of process to limit the hindering impacts of TCs. All these themes have been shown throughout this research as areas required for development to ensure positive sector evolution.

Contribution 3: Present EERS sector activities are considered to be siloed and reactive to cultural and societal requirements for retrofit. Impetus to increase innovative practices in saving energy is lacking.

As detailed within the Literature Review (section 2) the EERS sector itself is presently not significantly researched, and actually forms a subsector of the more general construction sector in many cases. However, the stated need for increased domestic property carbon savings, the call for increased knowledge regarding the sector and its potential have been reoccurring. Resultant is the theme that the sector and policy needs to focus on energy efficiency gap removal.

As stated in the previous chapter (6.6.4), the importance of innovation is high on the agenda to create a sector capable of tackling properties of all types in an effective professional manner. This transition to higher innovation and increased retrofit activity is suggested to be best realised via improved innovation of technology, materials and products, as well as social and business strategies welcoming innovation.

Contribution 4: Practitioner training to increase both practical retrofit skills and also to enhance customer care and business acumen needs to be prioritised. The importance of this is considered to be high and therefore for added sector credibility, accreditation needs to be widely promoted and rigorous in nature.

The issue of cowboy outfits and low levels of on-site problem solving was stated by numerous respondents within the research as an issue holding back the reputation of the EERS sector. From this, the concept of training was one repeatedly brought up as a strategy to create high levels of practitioners who can deliver projects in a streamlined manner, and operate within the sector for their entire career successfully. To enable this, apprenticeships were stated as a good way of training individuals in a time-served manner to ensure high levels of problem solving experience. Furthermore, the implementation of project managers on site was stated as another way in which to not only produce a smoother retrofit journey for the end user, but also an increased role for practitioners who have good organisation and management skills.

Contribution 5: Due to the complexities of different retrofit projects and schemes of works, the opportunity for costs and inefficiencies in terms of time and resources to escalate is high, therefore leanness in business structures and processes needs to be a key area of attention to promote heightened attractiveness of retrofit .

Due to high levels of tailoring required for retrofit projects, and also the need for significant levels of labour intensive process within schemes of works, one strategy stated to be of high importance is that of process efficiency to make sure all aspects of a retrofit project are completed within the quickest time possible, whilst not jeopardising quality. This attitude of ensuring process efficiency was also stated as important when considering producing businesses which are capable of high adaptability and flexibility to the requirements of varying customers. Of particular note here is the need to ensure that high levels of finance and resources are not pulled into situations dealing with TCs and hidden costs of operating a business. Instead a focus is needed on ensuring that companies and practitioners can evolve to deal with retrofit project requirements, and not have to face passing on the financial impact onto the client. If this can be achieved then not only are businesses and individuals predicted to receive more work and trade, but also the prospect of undertaking a retrofit project is higher, with no negative aspects affecting the client.

Stakeholder theory and TC analysis

This sub-section considers the research contribution made via the novel method of understanding EERS sector business evolution, via stakeholders and transaction prioritisation.

Contribution 6: Using Grounded Theory, this research has produced insights into the EERS sector which are entirely founded upon the experiences of EERS sector practitioners. Therefore learning can take place as to the actual impacts of past policy schemes and how improvements can be made into the future.

As a section of the literature review undertaken within this research (section 3.1.4), studies utilising stakeholder theory to assess business interaction with policy were only identified within a handful of cases (section 3.1.4). Furthermore, the review did not recognize any cases where the issue of TCs related to business growth had been implemented to establish the core issues related to the EERS sector and policy. Consequently, it is argued here that an important research contribution is the provision of an in depth, empirically grounded interpretation of the role of stakeholders and finance in the development of the EERS sector. Furthermore, this has delivered understandings of the various component types that comprise a company capable of implementing, and capturing value from a commercial service, enabling retrofit and carbon saving.

Additionally via the comparison of the EERS sector within the UK and Germany, there is the illumination here of the variances between a sector strategy which has recently struggled to work with policy, as is the case with the UK, and the business model of Germany, which has shown relatively higher levels of retrofit. This has generated a significant understanding of what a successful EERS sector could resemble.

Contribution 7: This research highlights that all business types need to adopt strategies to increase stakeholder involvement of all types in ensuring company development in the correct direction. This is in particular reference to ensuring that all commercial parties are focused on produced carbon savings projects which prioritise end users. Therefore, the value of partnerships and groups of businesses is deemed high. Consortiums promoted by government driven schemes are therefore considered key for progress.

This research agrees with the Conservative and Liberal Democrats coalition government's view that private sector business and individuals should be those who are likely to play a

main role in producing an EERS sector which is capable of tackling the issue of the UK's inefficient housing stock. This is particularly the case when the extent of present and potential expertise within the sector is considered. Furthermore, due to the fact that in many ways completing a retrofit project can be termed a challenge of expertise to deliver a quality scheme of works swiftly, the fostering of stakeholders who are all working to a similar aim is considered important. These stakeholders can also, particularly in the case of policy implantation retrofit work, include policy makers and public officials, making the issue of working together with high levels of communication even more important.

7.2.2 Cross border policy learning

This subsection details the contribution to UK policy, in terms of lessons which could be learnt from outside the national context.

Contribution 8: Finance provision across retrofit areas is considered successful in Germany. This is in terms of finance invested to provide end users with capital to complete works, and also in terms of commercial finance to invest in business process and product to enhance retrofit offerings. Of particular note is the need for a higher levels of flexibility and amount in UK retrofit finance provision.

The consensus across UK and German participants is that finance needs to be made widely available and flexible to enable the treatment of different types of properties and also to ensure that the end user receives the types of improvements that work for them. In addition, finance or incentives need to be made available to UK EERS sector business to enable enhancing training as suggested above, or fast tracking of product or process efficiency.

With this increased finance, enhanced capabilities, in terms of physical capacity, skill bases and also technical ability could result. With a focus on these areas, professionalism and the ability of any number or type of retrofit project can be dealt with. Feedback from German participants, also suggested that although they considered themselves at a more progressive position that their UK counterparts, there was still room for improvement, with continuing advancements in training and innovations, to stay in line with each other.

7.2.3 Retrofit enabling green growth

Retrofit throughout this research has been referred to as a useful method in which to generate economic growth, increased sustainability, and employment growth.

Contribution 9: Retrofit, via professional business conduction, has the ability to provide a key area of economic growth within the UK, employment opportunities, along with an important way in which to make a substantial carbon emission saving. From this viewpoint therefore, government incentivisation funds need to be increased, and policy makers view investment in incentives as a method to gain advantages on numerous levels.

What is prevalent from both the UK and German practitioner data is that overall, if client care is a priority, projects can be gained and significant levels of work received. With this level of work, economic returns for businesses and individuals can be substantial, with the EERS sector acting as a real life long area of career prospects. Moreover, as can be appreciated by the wide range of different participants who took part in this research, any Green Growth benefit is wide-ranging. The extent of this benefit can be viewed in a national context, to include growth in building product supply, innovation development, logistics, project management, and administration, or in a wider context to include those services and product brought in from overseas. This importing aspect, has been prevalent for multiple German respondents.

7.3 Further Research

With regards to further research, two potential key areas in need of attention are detailed below. The first proposes methods that further research could implement to overcome the limitations of this research, while the second area covers ways in which additional research could expand the research, to add reliability of results, and extent of applicable contexts.

7.3.1 Overcoming limitations

The methodology utilised here identified key aspects of the relationship between the EERS sector and policy, and presented key areas emergent from data collection processes. These aspects were deemed by participants as important, however enquiry into creating a hierarchy of issues with the present situation and resultant suggested pathways forward, did not take place. As a result, one research limitation here is that the creation of a focused approach to altering policy, and applying a certain change identified as most influential to increased retrofit rates, is not present here. In order to remove this limitation and enhance the recommendations detailed here, further research should comprise a secondary study with an increased sample size. The objective of this research should be to distil down suggestions of future policy pathways, to provide an outcome of specific policy ideas, and detailed plans of

how implementation should take place. To offer increased reliability of results, bringing EERS sector practitioners together with policy makers could provide a useful strategy to appreciate which policy suggestions would be best implemented to provide maximum impact and increased in retrofit rates.

Another limitation within this research is the issue of a potential lacking in results generalizability. This is particularly the case, due to the size of the participant samples, and therefore caution should be used before results are applied to different situations. In order to address this issue and to also increase the validity and reliability of the results, future studies should duplicate this research design with larger groups operating in different nations, thereby strengthening the resultant policy recommendations.

Equally, to evaluate result reliability, future research should also utilise the same strategies of sampling and questioning, thereby offering an identification of evolving issues of producing retrofit at scale, and thereby determining the stability of the relationship between sector and policy. Finally, further research routes should also use different methods of enquiry, encountering the sample in alternative methods, such as questionnaires or survey, or indeed action research and case studies of EERS sector operations, thereby creating increased validity due to the effect of result triangulation.

7.3.2 Extending results

Retrofitting the UK housing stock offers an important method in which to provide large carbon savings and improve the level of built environment energy performance. However, the scale of the task, which is laid at the door of the EERS sector, is substantial.

The complexity of the task means that potential policy interventions to increase retrofit rates could be trialed within certain areas of sample EERS sector business, thereby improving knowledge levels as to exactly how sector/policy relationship evolve over time within varying policy routes. This would extend the research here which terminates at the stage of suggesting policy pathways, and instead start to assess how policy changes impact the status quo in reality.

From the viewpoint of methods, there is also potential to build upon the previous statement and takes the types of policy suggestions which were resultant from the focus groups, and apply them in a market research style to other EERS sector members, to gain feedback as to their suitability, and also to produce an environment where participants could detail their predictions as to what effects could be resultant from the suggested policy changes.

7.4 Final thoughts

In conclusion, this research has identified, via policy learning, key areas which need improvement within the EERS sector policy relationship, along with pathways for policy improvements and resultant requirements of the retrofit implementation chain.

The academic route taken to gain these research outcomes and the discussion which have taken place, have provided a high level of personal learning. Furthermore, as someone with experience of operating within the EERS sector, it has been very satisfying to so readily meet individuals with high levels of expertise and enthusiasm, passionate about tackling the challenge of increasing retrofit levels. This attitude from practitioners has produced a personal outlook which is quite positive looking into the future, with an increased level of reassurance that there is the potential within the UK to produce significant carbon savings, whilst also creating a better environment for people to live within.

As well as addressing the research questions, this research has also led to significant developments within the researcher's knowledge of conducting enquiries with rigour. Plus there is also the hope that this research will in turn contribute to overall academic scholarship, and help reduce the negative impact of the energy efficiency gap.

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Appendix A: Interview of Retrofit practitioner

Introduction

Presentation of the research abstract and overview to participant.

This is an interview for a PhD study being conducted by Luke Gooding at Heriot Watt University, structured to explore your organisations perception of the Green Deal and its impact upon your business.
There are no right or wrong answers; it is your perceptions and opinions that matter.
Your confidentiality is assured and responses will not be linked to any particular individual.
All responses will be sent to yourself prior to inclusion in a written document.
**Seek permission to record, again assuring confidentially and correct data storage. Switch recording device on. **

Warm Up:

First of all could you tell me a little about yourself in terms of;

- Your name, position and organisation name.
- A description of customers, human resources, size of operation, location of operation.
- Could you tell me any information regarding your personal role and responsibilities?
- How long you have working in the industry?

Additional questions:

-How long has the business been trading?

-How many different revenue schemes does your business have?

-What kind of growth have these different revenue streams experienced over the past few years?

- In the main how are leads generated within your business?

-What types of clients do you cater for?

Changes in industry

Looking back over the past couple of years of trading, what type of changes or trends have you identified in how you operate, and how your business operates in general?

Additional probing questions:

-In your opinion what are the reasons for these changes, or lack of change?

-Do you perceive that these changes are positive or negative for the retrofit industry?

-Do you consider these impacts to be industry wide, or specific to only businesses such as your own?

Regarding the entire retrofit industry, how would you describe the way in which it operates?

Additional probing questions:

- How do you perceive the level of competition within the industry?
- Can you describe the way in which business, contractors and external practitioners operate, in your experience.
- What sorts of supply chains do you operate within?

Your business and policy

How are policies such as the Green Deal and Eco, impacting your business, what kinds of interaction do you have with the retrofit policy landscape.

Additional probing questions:

-Do policies provide you with a rewarding method of generating profit and growing your business?

- In your opinion to what extent do government schemes to increase retrofit provide a method of increase the supply of properties to your business.

- On an average day how do you interact with the Green Deal?

-In your opinion to what extent does the present policy system provide a suitable environment for industry to evolve and innovate?

-To what extent do you feel as if the Green Deal mechanism places yourself within a network of practitioners, and if so, to what extent do you feel this benefits you?

The Future

Looking at the way in which the industry presently operates, what ways do you think the industry and related policies succeed?

Additional probing questions:

-Do you think via government intervention, property retrofitting is on the increase?

-Do you think presently mechanisms are an improvement on past policy schemes?

-From a commercial perspective, do you consider the present system to be viable into the future to guarantee increase energy efficiency at scale?

In your opinion, if changes to policy are required, what needs to be addressed and for what reasons?

Additional questions:

-What areas of policy in particular in your opinion need attention to enable increase retrofit activity?

-What particular policy mechanisms, whether that is incentives or regulations, should be increased or focused on, in your opinion?

-How could your business practices be improved by a change in policy?

- How could the administration of policy be improved by a change in policy.

Many thanks for your time and contributions to this research.

Appendix B: Group interview question guide

Practitioner group interview, question scheme for Green Deal advisors and installers.

Part 1: General Background

Let's start by introducing ourselves, and telling the group a little about you.

-Which business/organisation

-Job title and key roles

Part 2: The retrofit industry.

How would you describe the UKs retrofit industry?

What are some examples of individuals you come into contact within when working in the supply and implementation chain?

How important is the network you operate within?

How would you describe the quality levels of projects you've been involved in?

Do you consider the number of innovations entering the industry sufficient?

Part 3. Changes in industry

Looking back at the industry over the past few years, what types of changes or trends have you seen?

How have the types of project you are involved with changed?

How have the technologies available changed?

How have you have to adapt to the changes that you have encountered?

Part 4. The industry and policy

How are policies such as the Green Deal and ECO impacting your businesses?

How do you interact with government policy?

Do policies provide a way to make extra profit and business growth?

Do policies aid property supply?

Do you interact with some policies more than others?

Do policies provide ways for the industry to evolve and innovate?

Do policies create a network of practitioners?

Part 5. The Future

Looking at the way in which the industry presently operates, what ways do you think the industry and related policies succeed?

What government measures boost customer numbers?

What government measures assist you to grow?

What strategies could you adopt to operate outside of government incentive schemes?

Do you see the future of the retrofit industry as one without intervention?

What specific things would you like to see change into the future?

Appendix C: Focus Group Topic Guide

Practitioner focus group, question scheme (operations manager, business development, policy interpretation executives).

Part 1: General Background

Let's start by introducing ourselves, and telling the group a little about you.

-Which business/organisation

-Job title and key roles

Part 2: The retrofit industry.

How would you describe the UKs retrofit industry?

PROBE

- The level of competition for projects within the industry?
- Networks of contractors and external practitioners?
-What sorts of supply chains exist for material sourcing?
-How are leads generated for retrofit works?

Part 3. Changes in industry

Looking back at the industry over the past few years, what types of changes or trends have you seen?

PROBE

-Potential reasons for changes in business? (Policy inputs/ economic changes).
-Do you perceive these to be positive or negative changes?
-Do you consider any changes to be industry wide?

Part 4. The industry and policy

How are policies such as the Green Deal and ECO impacting your businesses?

PROBE

-How do you interact with government policy?
-Do policies provide a way to make extra profit and business growth?
-Do policies aid property supply?
-Do you interact with some policies more than others?

-Do policies provide ways for the industry to evolve and innovate?

-Do policies create a network of practitioners?

Part 5. The Future

Looking at the way in which the industry presently operates, what ways do you think the industry and related policies succeed?

PROBE

-What government measures boost customer numbers?

-What government measures assist you to grow?

What way are changes needed?

PROBE

-Are there other ways policy could help you grow and carry out retrofit at a larger scale?

-Can you think of any particular policy mechanisms which you would like to see used?

Appendix D: Sample partial interview transcript

RS 38.05

I: Thanks ****** for agreeing to spare some time to speak with me.
R8: No problem at all.
I: By way of getting some background information, could you define the business you run here and the way you would classify it?

R8: Sure, well this operation you see now is a couple of different operations, including the establishment of property management software and also retrofit supply chain adaptation.

I: And how long have these different areas of operation being in place?

R8: We have been trading like this for a few years now, and we are now in the position where in essence it is a promotional game as we are trying to get more and more people on board to take notice of what we are doing here.

I: What is the type of geographical coverage you are also working with?

R8: We are not bounded geographically really, we do a lot of support working with clients which means we can be remote for much of the duration as we are about making the concept of retrofit much easier and that means more time can be spent off site.

I: And in terms of the number of staff you have working within the operation, how many do you have working as employees?

R8: I like to keep the workforce dynamic so that means to me having a core team who I know can work to a very high level together and then also have people who can come in on a part time or consultant basis to inject some pace and enable sprints in action.

I: Do you find these consultants or contractors useful in aiding the growth of your market?

R8: From my perspective absolutely, because if you use incoming staff correctly they can shake up a stagnating working environment, and because they are on a day rate, then the pace increases and everyone is pulled forward. So we regularly have these sprints to get sections of work completed in highly efficient and condensed timescales. I think it is the same for everyone, if you use a team correctly, you can get the best out of them, and I think that means keeping them moving and using all of their skills.

I: Could you tell me a little about what you do here, and the work of *********, and *********?

R8: I guess you could describe us as a consultancy, but our focus really is to education people about energy and the construction of houses. Whether that is energy advice, design, project management that kind of stuff. We have also done monitoring in the past and performance of buildings. The whole notion of it all is built around the concept that we are impartial. One of the things that I think is completely missing generally from the way that industry works is that the person who you are speaking to is also the person selling. So if you speak to a roofer you need a new roof and so on. So we are trying to fill that gap, whereby people can become educated without being tied into a purchase of services. Now there is not a huge amount of money in that, but we feel that it is something which is very important. We have clients who are individual householders as well as landlords, meaning that last month we reached the milestone of 1.2 million houses which we have assessed, now predominantly a large chunk of that is landlords. But we also do local authority work, so we will put together a strategy for a local geographical area. This involves the purchasing of EPC data, and that is then turned into some advice as to a path forward. But increasingly we are turning that data into tools, so increasingly a landlord will be able to buy software that we have designed, with a front end that they can play with, so they can see that for a particular house what the options are, what the savings are, what it will cost them, and then sit down with the home owner or tenant and work it out for themselves.
I: So there is obviously quite a development from what you have done in the past, all the way from assessment through to tool development, what has driven that? Is it the drying up of previous revenue streams?

R8: No, I think it is due to the development of the business, meaning we are seeing more and more areas for generating custom. Now, some things we do because it is cool, but others is

just where we are heading, so the software for instance was purely a decision of how can we help other companies and become a partner of choice if you like. So from that we are thinking that where the industry needs to be headed is a place where you can look at a retrofit and say to a homeowner, a year after the work is completed this is where your bills will be at, and this is the reason why they are bot what they would be, whether it is because the install has not been done very well, or the homeowner has turned the thermostat up, or something. So we want to be a in a position where we can diagnose that.
I: And more specifically looking at since the Green Deal came in, what do you think has changed in how your business operates?

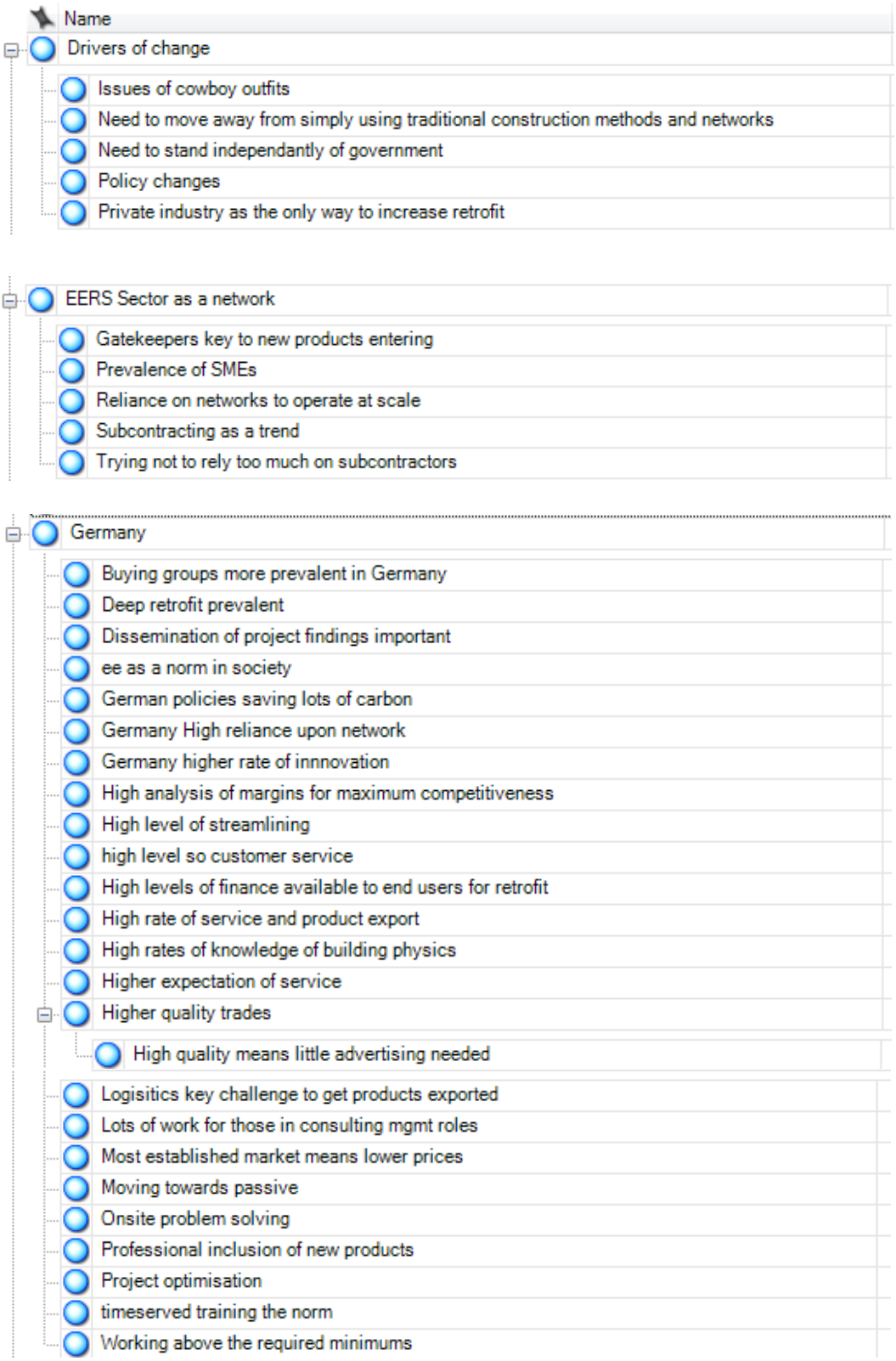
R8: Not a lot to be honest, we are fortunately at that end of the market, whereby people have a bit of money and understand it, so for private householders at least it hasn't changed. We have altered in the fact that our guys have become Green Deal assessors, and do Green Deal assessments, so we understand how bad they are. But having said that, the Green Deal is hand in hand with ECO funding and the whole debacle, it started off with us doing ECO assessment to show landlords how much ECO funding they could get, but then we have now moved into a space where we are telling people they don't need it and actually the government is not selling the money they have go very wisely. So we are showing them that they have money but it is just inefficiently spent. So in that respect there is plenty going on still with the grant. I think that there are plenty of companies who have completely just tied themselves to the grant and are simply going under. Manufacturers are actually the ones leading that charge and focusing their products on certain types of grant. And they have also gone for volume, and now they are absolutely terrified because of the low quality of the external wall insulation. So I think there are all sort of mal practice situations going on. I have heard of insulation companies putting aside huge piles of cash because of this.
I: Do you think ECO, is in any way an improvement of CERT or CESP?

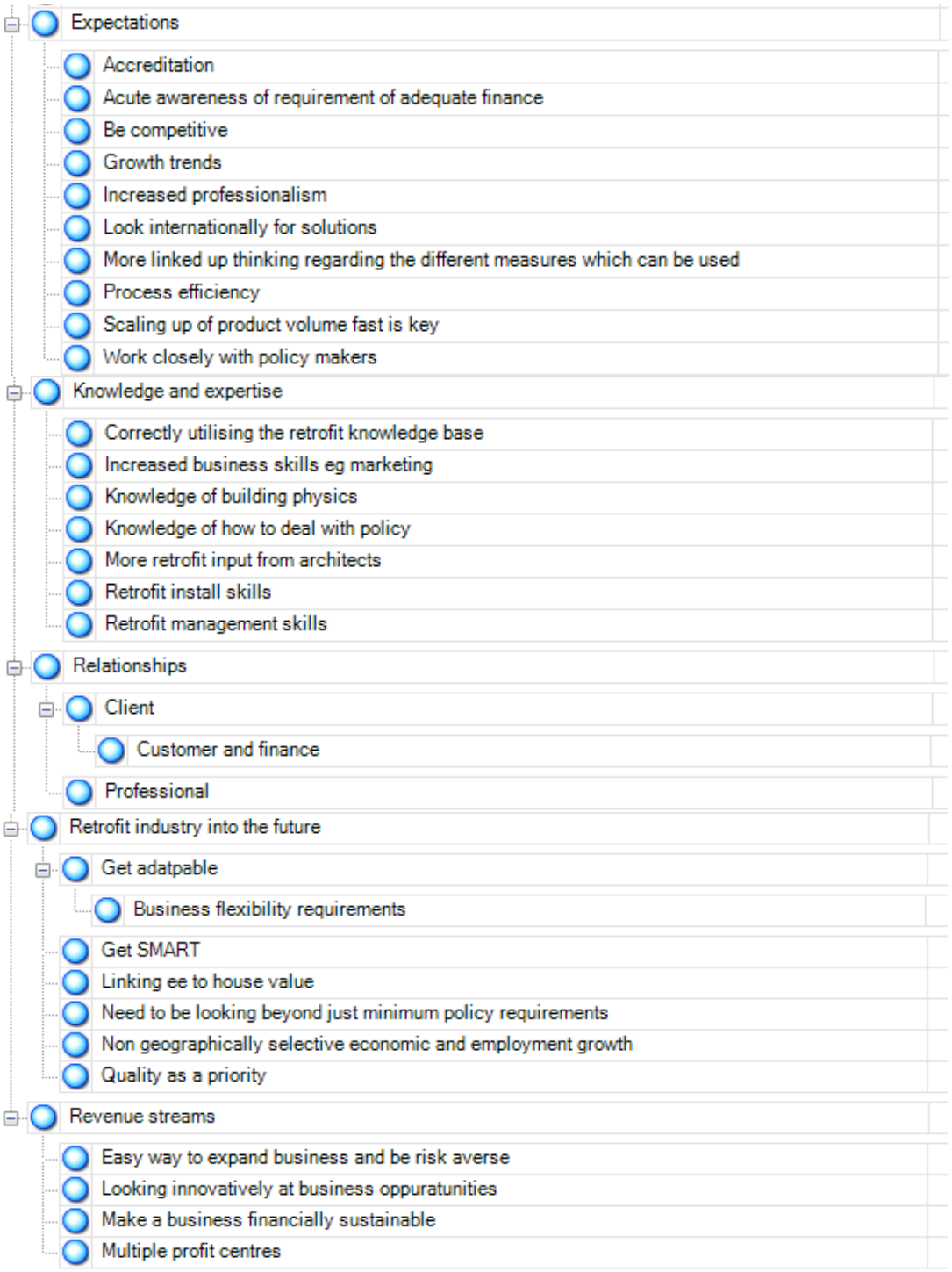
R8: It's the same thing, it is no different really, you have to fundamentally change it to make it work and be dynamic. The situation we are in is basically getting energy companies to spend some of their profits in an ethical way. And let's face it they don't really want to spend it, or they want to spend as little of it as possible, and also they want to get the maximum carbon saving to ensure they look as good as possible. So when it was lofts, they chucked it all into lofts, and when all the lofts were filled they went onto cavity walls, and when they are done they will just go on to the next cheapest thing. And then you have all these strange

situations where you have people trying to seek out hard to treat cavities. You know, last week the cavity was 55mm and now it is 49mm meaning it now qualifies for hard to treat. And that is what is keeping the biggest firms on the up and up, ******* for instance are the biggest guys doing this, and the biggest spender of ECO, and they will make around £7000 profit per property on hard to treat cavity.
I; And do you think purely from a supply of property perspective, whether ECO is flawed in its quality or not, do you think there are more properties coming through under ECO?

R8: No, what you have got with ECO, is that people can either bid for it or have done a bi lateral agreement on it, and they will then be allocated some funds and each business will then try and find the most profitable areas to put that funding, that includes the stuff that is allocated to the fuel poor. We are also finding with another schemes that we have here in North London, the Green Deal Communities project, that people are being allocated the work. So whilst you have got householders coming forward saying I want it done I want it done, you get people going round and doing a survey, and then the contractor then decides if they can be bothered if they are going to do the job or not, and worse still, there is no communication with the householder about this. So it is diabolical really. So it is funding which suits the supply chain, very rarely does it suit the householder. And the national insulation association, is one of the worst out there, I mean they go into government and say to them, we should be helping the fuel poor, but actually all they want is big chunks of money.

Appendix E: NVivo Open Coding Structure




Expectations
Accreditation
Acute awareness of requirement of adequate finance
Be competitive
Growth trends
Increased professionalism
Look internationally for solutions
More linked up thinking regarding the different measures which can be used
Process efficiency
Scaling up of product volume fast is key
Work closely with policy makers
Knowledge and expertise
Correctly utilising the retrofit knowledge base
Increased business skills eg marketing
Knowledge of building physics
Knowledge of how to deal with policy
More retrofit input from architects
Retrofit install skills
Retrofit management skills
Relationships
Client
Customer and finance
Professional
Retrofit industry into the future
Get adatpable
Business flexibility requirements
Get SMART
Linking ee to house value
Need to be looking beyond just minimum policy requirements
Non geographically selective economic and employment growth
Quality as a priority
Revenue streams
Easy way to expand business and be risk averse
Looking innovatively at business oppuratunities
Make a business financially sustainable
Multiple profit centres

Appendix F: Memo Sample

Memos

Name
Architects not set up for retrofit
Both goods and install have seen increases in trades over recent years
Business models which can be altered
Business rates of change not in line with rates of policy change
Business risk mitigation
Business who produce quality dont need to use policy work
Businesses looking for route of least resistance
Businesses must look to stand independently of government policies if at all possible
Businesses need to look at clients needs and the bottom line
Buying groups large consideration for new products
Central database of info needed
Clients want traditional construction too
Consistency of finance could produce bundling
Continual improvement needed
Customer contribution required
Customers asking for more than the builders
Deeper retrofit in Germany
Dialogue with policy makers needed
Differing types of innovators provide differing solutions
Dissemination needs to be carried out in the correct way
Divergence in what is best, combination of profit centres or dedicating everything to policy
Dont limit finance available, offer flexibility so passive could be possible
Dont reinvent the wheel just look overseas
Door knocking trend lack quality